NOTICE

All drawings located at the end of the document.

Groundwater Protection and Monitoring Program Plan for Rocky Flats Plant

In Compliance with DOE ORDER 5400.1

EG&G ROCKY FLATS

Manual No. 21000-MP-GPMP

REVIEWED FOR CLASSIFICATION/UCNI
By K. E. Callaway (UNI?)
Date 5/12/92

ADMIN RECORD

A-SW-000375

FINAL

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

Prepared For

U S DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE
GOLDEN, CO

Prepared by

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November 27, 1991

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Date 11/21/91 U.N.U.
5/13/92 (UNU)

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Executive Summary

Approved by

J W Langman — 2/15/92

Project Manager — Date

This is a CONTROLLED DOCUMENT

This is a RED Stamp

Reviewed for Classification /UCNI

By George H. Setlock

Date 11/21/91 UNU

EXECUTIVE SUMMARY

The purposes of this document are to define, describe, and evaluate the groundwater protection and monitoring program at the Rocky Flats Plant (RFP) and to comply with Department of Energy (DOE) Order 5400 1 The specific requirement of this Order which this plan addresses is the preparation of a Groundwater Protection Management Program that includes a groundwater monitoring plan, Chapter III, Section 4 a and Chapter IV, Section 9 of the Order, respectively, for each DOE facility at which the Order is applicable Sections 4 0 through 6 0 of this document focus on the groundwater monitoring plan aspect of the Order In essence, this document constitutes the Groundwater Protection and Monitoring Program Plan (GPMPP) for RFP

The definition of groundwater protection at RFP is the prevention, monitoring, and remediation of contaminated groundwater near and in the vicinity of the Plant and the protection of groundwater resources from over-development Protection is achieved through ongoing monitoring activities The analyses derived from this monitoring provide the means for evaluating the impact that certain plant operations may have on groundwater and limiting those activities that may adversely affect the quality of the groundwater in the area

The groundwater monitoring program will be kept current and modified as requirements and program needs change This document is to be reviewed annually and updated every three years In addition, the "Environmental Protection Implementation Plan Guidance for DOE Order 5400 1" also states the groundwater monitoring plan component can be used to satisfy the requirements for an environmental monitoring plan as described in Section II F, Environmental Monitoring Programs, of the guidance document

Section 1 0 of the GPMPP is an introduction to the various groundwater monitoring activities at RFP It describes the RFP physical setting as well as the series of events that relate to the groundwater monitoring program

Section 2 0 is a review of the geology, hydrogeology, major aquifers, rates of movement of groundwater, analytes for chemical characterization of the water, identified contamination, and interactions of groundwater with surface-water resources at RFP

Section 3 0 presents an analysis of the requirements contained in both the State and Federal regulations, DOE orders, Inter-Agency Agreement (IAG), and other agreements and evaluates their impact on the RFP groundwater monitoring program

Section 4 0 describes the Groundwater Protection and Monitoring Program Specifically, this section of the Plan details the DOE and EG&G program organization and the present groundwater monitoring, protection, and remediation programs

Section 5 0 evaluates the Groundwater Protection and Monitoring Program and how it complies with the technical and regulatory requirements

Section 6 0 describes an introspective study that has led to a number of self-improvements that will aid the groundwater monitoring program and ensure its continued compliance with DOE requirements

Section 7 0 briefly describes future decontamination and decommissioning plans that are expected to impact RFP groundwater programs and identifies the amount of time required to accomplish these activities

Section 8 0 describes the funding and budgeting procedures at RFP Included in the text are details about the Activity Data Sheets (ADSs) that are used to prepare the DOE Five-

Year Plan This section also details the interactions between RFP and the surrounding communities

MAJOR FACTORS GOVERNING GROUNDWATER MONITORING AT RFP

Included in the State and Federal environmental regulations pertaining to groundwater protection are the Colorado Hazardous Waste Act, the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) In general, groundwater monitoring under RCRA is similar to that under CERCLA in that the primary objective is to assess the impact of a facility or site on the groundwater beneath the site, although CERCLA monitoring is generally directly related to site remediation RCRA requires that a hazardous waste treatment, storage, and disposal facility be treated as either an Interim Status or a Fully Permitted facility

According to the RCRA Interim Status regulations, the facility's groundwater monitoring program must, at all times, comply with the requirements of one of at least the following types of groundwater monitoring systems Initial Groundwater Monitoring System, Groundwater Quality Assessment Program, or an Alternate Groundwater Monitoring System

RFP GROUNDWATER PROTECTION AND MONITORING PLAN

Three hundred seventy-one wells and piezometers are included in the groundwater monitoring program at the RFP (Plate 1) Of these, two hundred fifty-nine are sampled The program has been designed to measure the concentration of hazardous constituents, assess the rate of movement, and determine the extent of contaminant plumes in the uppermost aquifer within the RFP boundaries The "uppermost aquifer" is described in Section 2 2 of this document Three Individual Hazardous Substance Sites (IHSSs), the

Solar Evaporation Ponds (IHSS 101), the Present Landfill (IHSS 114), and the West Spray Field (IHSS 168) at the RFP are subject to Interim Status groundwater monitoring requirements under RCRA The remainder of the RFP IHSSs are either subject to groundwater monitoring regulations under CERCLA or do not require a groundwater monitoring system

The groundwater protection component of the program involves interpretation of quarterly groundwater data and subsequent treatment of groundwater that is found to be contaminated This component of the plan has focused on evaluating the impact of past and present Plant operations on groundwater quality at the RFP Any activity that could have an adverse effect on groundwater quality must be reviewed by the RFP hydrogeology staff as well as other groups and assessed against the National Environmental Policy Act (NEPA) regulations The project can begin only after it has been found that the activity will not have a significant negative impact Projects that involve excavations or other intrusive work are of particular concern, because these activities could adversely impact groundwater by introducing contamination into the uppermost aquifer and other hydrostratigraphic units

The RFP also has a specially trained hazardous materials response team that can respond quickly to hazardous or mixed waste spills that, if not cleaned up in a timely fashion, could pose a threat to groundwater resources in the area

The existing Groundwater Protection and Monitoring Program in use at the RFP includes a Groundwater Quality Assessment Program and an Alternate Groundwater Monitoring System that comply with the RCRA requirements of 40 CFR 265 90 (d) and 265 93 and the State regulatory requirements of 6 CCR 1007-3, 265 90(d) and 265 93, and with the CERCLA regulations of 40 CFR 300 430 Included in the RFP monitoring program are

- A network of background wells,

- A network of monitoring wells,
- A monthly measurement of water elevations,
- A quarterly sampling and analysis program,
- An assessment program,
- A program for reporting information to the appropriate regulatory agencies on a quarterly and annual basis,
- A well abandonment and replacement program,
- An annual evaluation program,
- A protection program, and
- A special projects program

Following quarterly groundwater sampling and laboratory analyses, analytical results undergo data validation and then are entered into the Rocky Flats Environmental Database System (RFEDS) for future retrieval and evaluation

The RFP groundwater monitoring program has been evaluated and every effort is being made to ensure it is in compliance with both the State and Federal regulatory requirements Each quarter, following receipt of the RCRA data, these data are evaluated using appropriate assessment techniques The results of these assessments are reported to the Colorado Department of Health (CDH) and the Environmental Protection Agency (EPA) on an annual basis by March 1 of the following calendar year Any changes in the monitoring program or in the Operable Unit (OU) workplans will be approved by the lead regulatory agency

SELF-IMPROVEMENTS

The following improvements are considered to be self-improvements that are needed in the RFP groundwater program These self-improvements have been identified during preparation of this document and during other groundwater program activities

- At the current time, procedures are being developed to effectively track water-quality data from point of origination (field sample collection) until these data are entered into RFEDS By effectively tracking the samples from collection to entry into RFEDS, the turnaround time of the data can be reduced to a maximum of 90 days This is considered a reasonable length of time for data to be incorporated into the quarterly assessments

- The required documentation for the RCRA quarterly groundwater analysis reports will be specified and a set of guidelines established Streamlining the format of RFEDS reports and subsequent statistical analyses will aid in timely completion of data evaluations for possible groundwater concerns The development of these reports will be performed by a subcontractor until the RFP has added the necessary staff to prepare them

- Incorporation of hydrologic and geochemical data on a routine basis into the site's hydrogeologic model will ensure that the groundwater monitoring program is in compliance with RCRA requirements and that the rate and extent of contaminant migration are adequately characterized Observed changes can then be evaluated to assess if installation of additional monitoring wells or initiation of other investigations is necessary

- An analytical evaluation of data sources to reduce redundant data collection will result in major cost savings Wells in close proximity monitoring the same hydrogeologic unit resulting in replicated data will be eliminated to avoid duplication A shortened analyte list will be established to monitor known contaminants in order to avoid sampling for insignificant constituents at specific locales

- A self-audit of the groundwater monitoring program will be held on an annual basis The self audit will include inspecting the groundwater monitoring system for compliance to all regulatory requirements, proposed requirements, and guidance applicable to groundwater monitoring Following this study, there will be a detailed inspection and tour of groundwater monitoring sites to look for possible compliance issues or determine the need for program improvements The findings then will be evaluated to determine whether or not a need exists to implement changes and/or improvements to the existing program

BUDGETARY REQUIREMENTS

At least $8 6 million are necessary in fiscal year (FY) 1992 in order to effectively administer and implement the Groundwater Protection and Monitoring Program Plan These funds will be used to sample, analyze, assess, and report the groundwater monitoring data They will also be used to evaluate the existing monitoring wells to select which ones should be abandoned, possibly replaced, or sampled less frequently

Future budgetary needs are estimated to be as follows

Fiscal Year	Estimated Number of Wells in Program	Estimated Budget $ (x 1,000)
1992	259	8,603
1993*	500	14,000
1994-1997*	475	14,500

* Includes wells that will be transferred to Plant and Support after one year of sampling as RFI/RI characterization wells

ROCKY FLATS PLANT GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN	Manual No Procedure No Effective Date Organization	21000-MP-GPMP 1 0, Rev 0 2/15/92 Environmental Management

Introduction

Approved by

J W Langman 2/18/92

Project Manager Date

This is a CONTROLLED DOCUMENT

Reviewed for Classification /UCNI

By George H. Setlock

Date 11/21/91 UNU

GROUNDWATER PROTECTION & MONITORING PROGRAM PLAN

1 0 INTRODUCTION

1 1 Purpose

The purposes of this document are to define, describe, and evaluate the Groundwater Protection and Monitoring Program at Rocky Flats Plant (RFP[1]) and to comply with Department of Energy (DOE) Order 5400 1 (DOE, 1988a) which requires the preparation of a Groundwater Protection Management Program that includes a groundwater monitoring plan (Chapter III, Section 4 a and Chapter IV, Section 9 of the Order, respectively) for each DOE facility at which the Order is applicable These sections are addressed and together they constitute the Groundwater Protection and Monitoring Program Plan (GPMPP) for the RFP The monitoring program will be kept current and revised as processes change This document is to be reviewed annually and updated every three years In addition, the "Environmental Protection Implementation Plan Guidance for DOE Order 5400 1" states the groundwater monitoring plan can be used to satisfy the requirements for an Environmental Monitoring Plan as described in Section II F, Environmental Monitoring Programs, of the guidance document

This document describes the various management practices of groundwater at the RFP ensuring that groundwater monitoring is providing the information necessary to properly manage and protect the groundwater resources of the area A summary of the hydrogeology of the site, major aquifers, movement of groundwater, potential sources of groundwater pollution, and uses of groundwater in the vicinity of the RFP site is provided Also presented are the groundwater protection and monitoring programs, as well as a review of the number of monitoring wells, sampling methods, sampling frequency, analyses performed, and a summary of results of these analyses In addition, this

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[1] A list of acronyms used in this document is presented in Appendix A

document presents an analysis of the requirements of the regulations, agreements, and DOE orders and evaluates their impact on the groundwater monitoring program It then describes improvements that need to be made in order to better comply with the requirements or the technical intent of the groundwater monitoring program

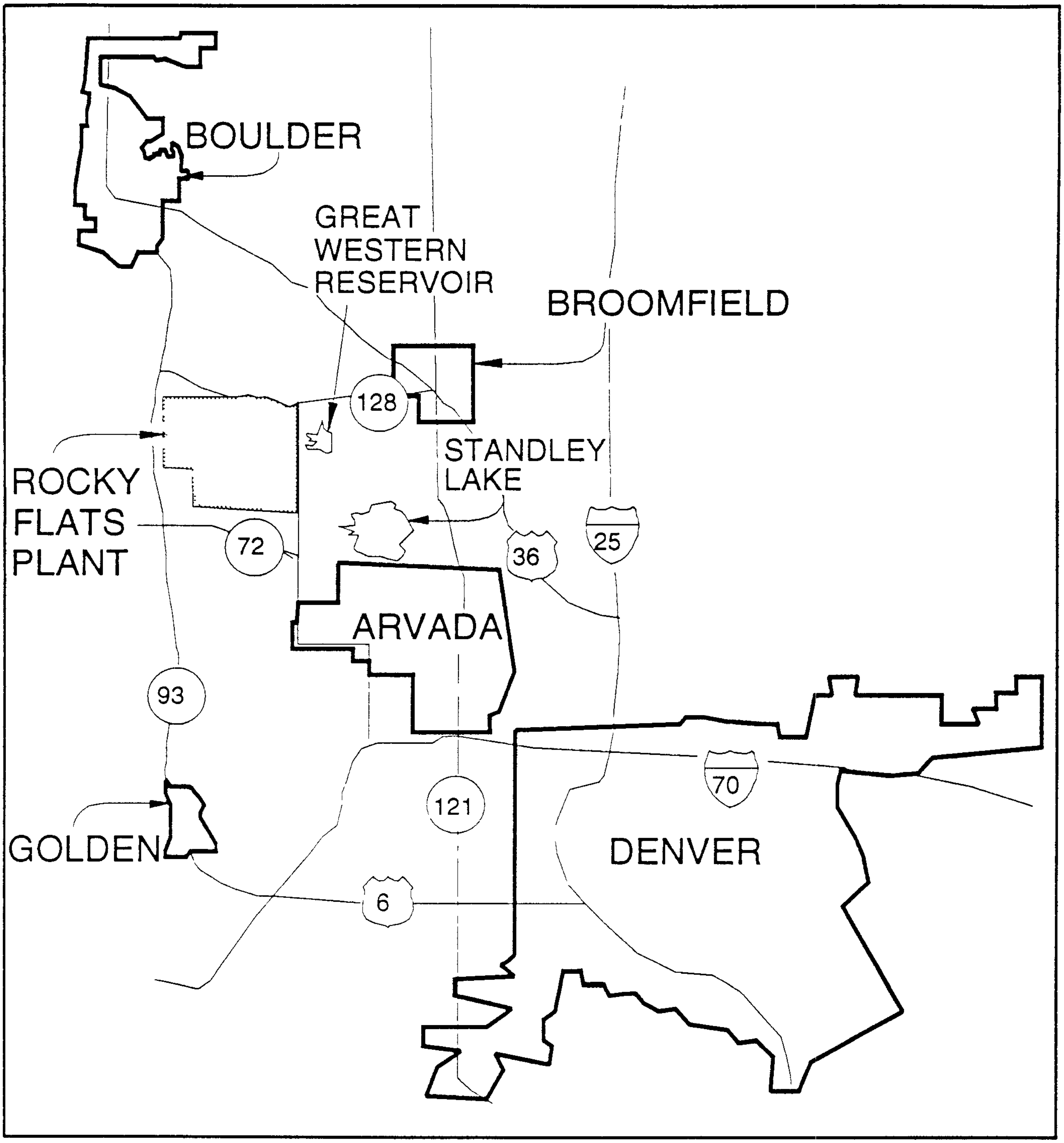
1.2 Rocky Flats Plant Description

The RFP, located 16 miles northwest of the Denver metropolitan area in Jefferson County, Colorado, encompasses approximately 6,550 acres of Federally-owned land (Figure 1-1) The RFP is a government-owned and contractor-operated facility that was both constructed and began operations in 1951

The RFP is part of the nationwide nuclear weapons research, development, and production complex The Plant produces metal components for nuclear weapons from plutonium, uranium, beryllium, and stainless steel Other production activities include chemical recovery and purification of recyclable transuranic radionuclides, metal fabrication and assembly, and related quality control functions The Plant conducts research and development programs in metallurgy, machining, non-destructive testing, coatings, remote engineering, chemistry, and physics Parts manufactured at the Plant are shipped off-site for final assembly

Major Plant structures, including all production buildings, are located within a 400-acre controlled area of the RFP facility (Figure 1-2) A 6,150-acre buffer zone is present around the perimeter of the controlled area

The RFP operations generate solid and liquid nonhazardous, hazardous, radioactive, and mixed radioactive waste streams These wastes are handled and disposed of in a variety of ways Solid nonhazardous/nonradioactive wastes are disposed of in an on-site landfill



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APPROXIMATE SCALE 1" = 5 MILES

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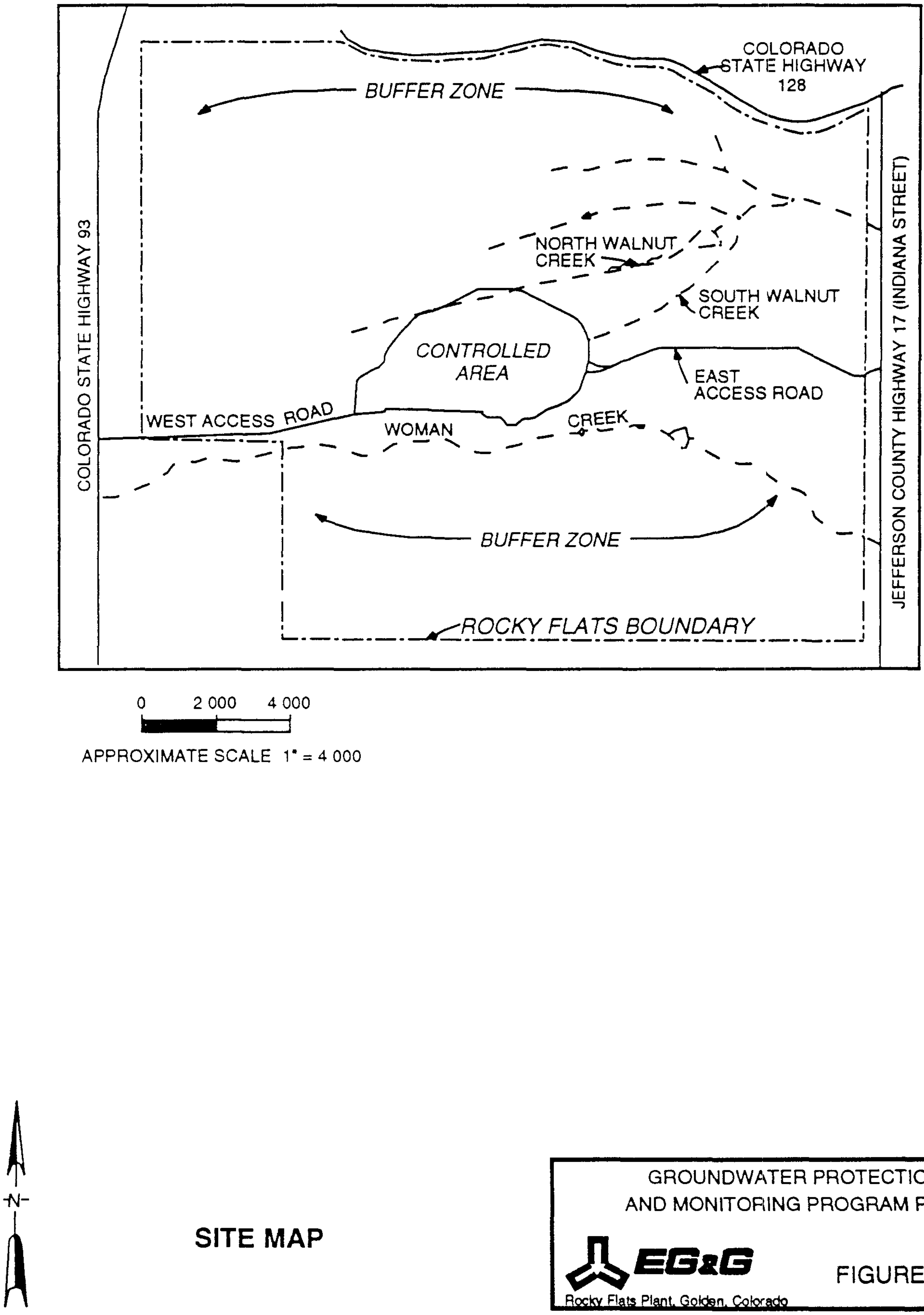
LOCATION MAP

GROUNDWATER PROTECTION
AND MONITORING PROGRAM PLAN

EG&G

Rocky Flats Plant, Golden, Colorado

FIGURE 1-1



SITE MAP

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

EG&G

Rocky Flats Plant, Golden, Colorado

FIGURE 1-2

Hazardous and mixed radioactive wastes are treated on-site, recycled, stored on-site, or shipped off-site for disposal

1.3 Environmental History of the Rocky Flats Plant

1.3.1 Definition and Identification of Solid Waste Management Units

The RFP has existed with various levels of operational capabilities since 1951 Since that time, levels of environmental protection were provided that, at the time, seemed consistent with prudent environmental management However, some activities have resulted in environmental contamination of portions of the RFP The existence of these areas has been documented a number of times during the operating history of the RFP In particular, most older areas of contamination were identified in reports generated during the transition from Dow Chemical management of the RFP to Rockwell International management of the RFP in the mid-1970s

One of the requirements of the RCRA regulations that became applicable to the RFP with the signing of a Compliance Agreement, on July 31, 1986 (Compliance Agreement, 1986) was that all Solid Waste Management Units (SWMUs) be identified as required by Section 3004(u) of the RCRA code

In 1986, the exact definition of SWMUs had not been formalized Therefore, the RFP used guidance supplied by the State of Colorado and the regional office of the U S Environmental Protection Agency (EPA) (EPA, 1985) This guidance required the identification of all areas where any environmental release may have occurred Waste- and non-waste-related releases were included in this definition, as were areas where only a single release occurred Also included were areas where long-term management of waste may have occurred SWMUs at the RFP have been renamed Individual Hazardous Substance Sites (IHSSs) in the Inter-Agency Agreement (IAG) (EPA, 1991)

The first identification of the RFP SWMUs, consistent with the guidance provided at the time by the State of Colorado and the regional EPA, was presented as an appendix to the November 1986 RCRA Part B Permit Application (Rockwell International, 1986a) SWMUs were initially identified in the Draft Comprehensive Environmental Assessment and Response Program Phase I Installation Assessment (DOE, 1985) which incorporated records search, open literature survey, and interviews with the RFP employees SWMUs consist of inactive waste disposal sites, accidentally contaminated sites, and sites found to pose environmental concern due to past or current waste management practices Inspections were conducted on each site and further characterization through field investigations and data-collection programs are ongoing

As discussed in RCRA guidance (EPA, 1989) and RCRA proposed regulations (Federal Register, 1990a), SWMUs are defined as locations where waste management occurred and where a long-term release may have occurred A release of non-waste materials or a one-time spill of waste does not qualify an area as a SWMU under this definition IHSSs are defined in the IAG (see Section 3 2 8) of this report as " locations associated with a release or threat of release of hazardous substances which may cause harm to human health and/or the environment " IHSS is a term specific to the RFP as a result of the IAG All previously identified SWMUs at the RFP became IHSSs due to the negotiations for the IAG These IHSSs will be investigated according to schedules presented in the IAG

New IHSSs have been identified as a result of ongoing environmental activities and the list of IHSSs has been updated a number of times Each IHSS identified at the RFP is considered a potential source of environmental contamination and therefore also is a potential source of groundwater contamination A comprehensive list of all IHSSs is given in Table 1-1 Each of the IHSSs has been assigned to one of sixteen Operable Units (OUs) (Appendix B) Table 1-2 is a list of each OU and its related IHSSs Plate 1 is a

Table 1-1

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

	IHSS No	Site Name
1	101	207 Solar Evaporation Ponds
2	102	Oil Sludge Pit
3	103	Chemical Burial
4	104	Liquid Dumping
	105	Out-of-service Fuel Tanks
5		105 1 Westernmost Tank
6		105 2 Easternmost Tank
7	106	Outfall
8	107	Hillside Oil Leak
9	108	Trench T-1
10	109	Trench T-2
11	110	Trench T-3
	111	Trenches T-4 to T-11
12		111 1 Trench T-4
13		111 2 Trench T-5
14		111 3 Trench T-6
15		111 4 Trench T-7
16		111 5 Trench T-8
17		111 6 Trench T-9
18		111 7 Trench T-10
19		111 8 Trench T-11
20	112	903 Drum Storage Area
21	113	Mound Area
22	114	Present Landfill
23	115	Original Landfill
	116	Multiple Solvent Spills
24		116 1 West Loading Dock Area
25		116 2 South Loading Dock Area
	117	Chemical Storage
26		117 1 North Site
27		117 2 Middle Site
28		117 3 South Site
	118	Multiple Solvent Spills

Table 1-1 - Continued

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

IHSS No		Site Name
29		118 1 West of Building 730
30		118 2 South End of Building 776
	119	Multiple Solvent Spills
31		119 1 West Area
32		119 2 East Area
	120	Fiberglassing Areas
33		120 1 North of Building 664
34		120 2 West of Building 664
35	121	Original Process Waste Lines
36	122	Underground Concrete Tank
	123	Valve Vault 7
37		123 1 Valve Vault 7
38		123 2 Valve Vault West of Building 707
	124	Radioactive Liquid Waste Storage Tank
39		124 1 30,000 Gallon Tank (T-68, Unit 55 14)
40		124 2 14 000 Gallon Tank (T-66, Unit 55 15)
41		124 3 14,000 Gallon Tank (T-67, Unit 55 16)
42	125	Holding Tank
	126	Out-of-Service Process Waste Tanks
43		126 1 Westernmost Tank
44		126 2 Easternmost Tank
45	127	Low-level Radioactive Waste Leak
46	128	Oil Burn Pit No 1
47	129	Oil Leak
48	130	Radioactive Site - 800 Area Site #1
49	131	Radioactive Site - 700 Area Site #1
50	132	Radioactive Site - 700 Area Site #4
	133	Ash Pits
51		133 1 Ash Pit 1-1
52		133 2 Ash Pit 1-2
53		133 3 Ash Pit 1-3
54		133 4 Ash Pit 1-4
55		133 5 Incinerator

Table 1-1 - Continued

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

	IHSS No	Site Name
56		133 6 Concrete Wash Pad
57	134	Lithium Metal Destruction Site
58	135	Cooling Tower Blowdown
	136	Cooling Tower Ponds
59		136 1 Northeast Corner of Building 460
60		136 2 West of Building 460
61		136 3 S of Bldg 460, W of Bldg 444
62	137	Cooling Tower Blowdown - Bldg 774
63	138	Cooling Tower Blowdown - Bldg 779
	139	Caustic/acid Spills
64		139 1 Hydroxide Tank Area
65		139 2 Hydrofluoric Acid Tanks
66	140	Reactive Metal Destruction Site
67	141	Sludge Dispersal
	142	Retention Ponds (A, B, C-series)
68		142 1 A-1 Pond
69		142 2 A-2 Pond
70		142 3 A-3 Pond
71		142 4 A-4 Pond
72		142 5 B-1 Pond
73		142 6 B-2 Pond
74		142 7 B-3 Pond
75		142 8 B-4 Pond
76		142 9 B-5 Pond
77		142 10 C-1 Pond
78		142 11 C-2 Pond
79		142 12 Newly Identified A-5 Pond
80	143	Old Outfall
81	144	Sewer Line Break
82	145	Sanitary Waste Line Leak
	146	Concrete Process Waste Tanks
83		146 1 7,500 Gallon Tank (#31)
84		146 2 7,500 Gallon Tank (#32)

Table 1-1 - Continued

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

	IHSS No	Site Name
85		146 3 7,500 Gallon Tank (#34w)
86		146 4 7,500 Gallon Tank (#34e)
87		146 5 7,500 Gallon Tank (#30)
88		146 6 7,500 Gallon Tank (#33)
	147	Process Waste Leaks
89		147 1 Maas Area
90		147 2 Owen Area
91	148	Waste Spills
92	149	Effluent Pipe
	150	Radioactive Liquid Leaks (8)
93		150 1 North of Building 771
94		150 2 West of Building 771
95		150 3 Between Buildings 771 and 774
96		150 4 East of Building 750
97		150 5 West of Building 707
98		150 6 South of Building 779
99		150 7 South of Building 776
100		150 8 Northeast of Building 779
101	151	Fuel Oil Leak
102	152	Fuel Oil Tank
103	153	Oil Burn Pit No 2
104	154	Pallet Burn Site
105	155	903 Lip Area
	156	Radioactive Soil Burial
106		156 1 Building 334 Parking Lot
107		156 2 Soil Dump Area
	157	Radioactive Site
108		157 1 North Area
109		157 2 South Area
110	158	Radioactive Site - Bldg 551
111	159	Radioactive Site - Bldg 559
112	160	Radioactive site - Bldg 444 Parking Lot
113	161	Radioactive site - Bldg 664

Table 1-1 - Continued

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

	IHSS No	Site Name
114	162	Radioactive Site - 700 Area Site #2
	163	Radioactive Site - 700 Area Site #3
115		163 1 - Wash Area
116		163 2 - Buried Slab
	164	Radioactive Site - 800 Area Site #2
117		164 1 Concrete Slab
118		164 2 Building 886 Spills
119		164 3 Building 889 Storage Pad
	165	Triangle Area
120	166	Trenches
121		166 1 Trench A
122		166 2 Trench B
123		166 3 Trench C
	167	Spray Fields - Three Sites
124		167 1 North Area
125		167 2 Pond Area
126		167 3 South Area
127	168	West Spray Field
128	169	Waste Drum Peroxide Burial
129	170	P U & D Storage Yard - Waste Spills
130	171	Solvent Burning Ground
131	172	Central Avenue Waste Spill
132	173	Radioactive Site - 900 Area
133	174	P U & D Container Storage Facilities (2)
134	175	S&W Bldg 980 Container Storage Facility
135	176	S&W Contractor Storage Yard
136	177	Building 885 Drum Storage Area
137	178	Building 881 Drum Storage Area
138	179	Building 865 Drum Storage Area
139	180	Building 883 Drum Storage Area
140	181	Building 334 Cargo Container Area
141	182	Building 444/453 Drum Storage Area
142	183	Gas Detoxification Area

Table 1-1 - Continued

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

	IHSS No	Site Name
143	184	Building 991 Steam Cleaning Area
144	185	Solvent Spill
145	186	Valve Vault 12
146	187	Acid Leaks (2)
147	188	Acid Leak
148	189	Multiple Acid Spills
149	190	Caustic Leak
150	191	Hydrogen Peroxide Spill
151	192	Antifreeze Discharge
152	193	Steam Condensate Leak
153	194	Steam Condensate Leak
154	195	Nickel Carbonyl Disposal
155	196	Water Treatment Plant Backwash Pond
156	197	Scrap Metal Sites
157	198	(Deleted)
158	199	Contamination of the Land Surface
159	200	Great Western Reservoir
160	201	Standley Reservoir
161	202	Mower Reservoir
162	203	Inactive Hazardous Waste Storage Area
163	204	Original Uranium Chip Roaster
164	205	Bldg 460 Sump #3 Acid Side
165	206	Inactive D-836 Hazardous Waste Tank
166	207	Inactive 444 Acid Dumpster
167	208	Inactive 444/447 Waste Storage Area
168	209	Surface Disturbance Southeast of Bldg 881
169	210	Unit 16, Building 980 Cargo Container
170	211	Unit 26, Building 881 Drum Storage
171	212	Unit 63, Building 371 Drum Storage
172	213	Unit 15, 904 Pad Pondcrete Storage
173	214	Unit 25, 750 Pad Pondcrete and Saltcrete Storage
174	215	Unit 55 13 - Tank T-40

Table 1-1 - Continued

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

IHSS No		Site Name
	216	East Spray Fields
175		216 1 North Area
176		216 2 Center Area
177		216 3 South Area
178	217	Unit 32, Building 881, CN Bench Scale Treatment

Source EPA, 1991

Table 1-2

ORGANIZATION OF INDIVIDUAL SITES INTO OPERABLE UNITS (OUs)

OPERABLE UNIT	OPERABLE UNIT NAME	INDIVIDUAL HAZARDOUS SUBSTANCE SITES
1	881 Hillside	102, 103, 104, 105 1, 105 2, 106, 107, 119 1, 119 2, 130, 145
2	903 Pad, Mound & East Trenches	108, 109, 110, 111 1, 111 2, 111 3, 111 4, 111 5, 111 6, 111 7, 111 8, 112, 113, 140, 153, 154, 155, 183, 216 2, 216 3
3	Offsite Areas	199, 200, 201, 202
4	Solar Ponds	101
5	Woman Creek Drainage	115, 133 1, 133 2, 133 3, 133 4, 133 5, 133 6, 142 10, 142 11, 209
6	Walnut Creek Drainage	141, 142 1, 142 2, 142 3, 142 4, 142 5, 142 6, 142 7, 142 8, 142 9, 142 12, 143, 165, 166 1, 166 2, 166 3, 167 1, 167 2, 167 3, 216 1
7	Present Landfill	114, 203
8	700 Area	118 1, 118 2, 123 1, 123 2, 125, 126 1, 126 2, 127, 132, 135, 137, 138, 139 1, 139 2, 144, 146 1, 146 2, 146 3, 146 4, 146 5, 146 6, 149, 150 1, 150 2, 150 3, 150 4, 150 5, 150 6, 150 7, 150 8, 151, 159, 163 1, 163 2, 172, 173, 184, 188
9	OPWL	121
10	Other Outside Closures	124 1, 124 2, 124 3, 129, 170, 174, 175, 176, 177, 181, 182, 205, 206, 207, 208, 210, 213, 214
11	West Spray Field	168
12	400/800 Area	116 1, 116 2, 120 1, 120 2, 136 1, 136 2, 136 3, 147 1, 147 2, 157 2, 187, 189
13	100 Area	117 1, 117 2, 117 3, 122, 128, 134, 148, 152, 157 1, 158, 169, 171, 186, 190, 191
14	Radioactive Sites	131, 156 1, 156 2, 160, 161, 162, 164 1, 164 2, 164 3
15	Inside Building Closures	178, 179, 180, 204, 211, 212, 215, 217
16	Low Priority Sites	185, 192, 193, 194, 195, 196, 197

Source EPA, 1991

topographic index map of the RFP that shows the IHSSs and their locations relative to the monitoring wells at the RFP

1 3 2 Groundwater Reports

Routine reports related to groundwater at the RFP are the Annual Environmental Monitoring Report required by DOE and the Annual RCRA Groundwater Monitoring Report for Regulated Units The Annual Environmental Monitoring Report has been published for approximately 20 years The Annual RCRA Groundwater Monitoring Report addresses those specific to RCRA Interim Status regulated units for which groundwater monitoring is required (Solar Evaporation Ponds, OU4, Present Landfill, OU7, and West Spray Field, OU11)

A large amount of groundwater information also is available in the remediation-related reports that have and will accompany all remedial activities and investigations, regardless of whether these activities are RCRA or CERCLA related The remediation-related reports typically present available information that can be used to characterize the hydrogeologic and contamination conditions of a site This type of information is presented to identify what remedial actions may be needed to comply with regulatory requirements as well as to identify available information needed to formulate a remedial action plan A list of the remediation-related reports that have already been produced on behalf of the RFP is provided in Table 1-3 A schedule for the preparation of future remediation-related reports can be found in the schedules attached to the IAG (see Section 3 2 8 of this report for more details on the IAG)

Table 1-3

Remediation- and Characterization-Related Reports

Report	Regulatory Driver	Date
Solar Evaporation Ponds Closure Plan	RCRA	11-86
Solar Evaporation Ponds Closure Plan	RCRA	3-87
Solar Evaporation Ponds Closure Plan	RCRA	7-88
Draft, Solar Evaporation Ponds Phase I RFI/RI Work Plan, Operable Unit #3	RCRA/ CERCLA	6-90
Present Landfill Closure Plan	RCRA	11-86
Present Landfill Closure Plan	RCRA	7-88
Draft Final, Phase I RFI/RI Work Plan Present Landfill, SWMUs 114 and 203, Operable Unit #3	RCRA/ CERCLA	6-90
West Spray Field Closure Plan	RCRA	11-86
West Spray Field Characterization Report	RCRA	10-88
West Spray Field Closure Plan	RCRA	10-88
Draft, West Spray Field Phase I RFI/RI Work Plan, Operable Unit #3	RCRA/ CERCLA	6-90
Remedial Investigation Report - 881 Hillside	CERCLA	7-87
Remedial Investigation Report - 881 Hillside	CERCLA	3-88
Interim Measures/Interim Remedial Action Plan and Decision Document, 881 Hillside	RCRA/ CERCLA	1-90
Response to EPA and CDH Comments on the Draft Phase III RI/FS Work Plan, 881 Hillside Area, Operable Unit #1	RCRA/ CERCLA	10-90
Final Phase III RFI/RI Workplan 881 Hillside Area OU1	RCRA/ CE RLA	10-90
Responsiveness Summary of IM/IRAP and Decision Document 881 Hillside OU1	RCRA/ CE RLA	1-90
881 Hillside RI/FS Responses to EPA Comments	CE RLA	2-89
Feasibility Study Report for High Priority Sites 881 Hillside Area	CERLA	3-88
Final Phase III RFI/RI Work Plan, 881 Hillside Area, Operable Unit #1, Revision 1	RCRA/ CERCLA	3-91

Table 1-3 - Continued

Remediation- and Characterization-Related Reports

Report	Regulatory Driver	Date
Remedial Investigation Report 903 Pad, Mound and East Trenches	CERCLA	12-87
Remedial Investigation Report 903 Pad, Mound and East Trenches	CERCLA	9-89
Phase II RI/FS Work Plan, 903 Pad, Mound and East Trenches Areas, Operable Unit #2	RCRA/ CERCLA	12-89
Comments and the Draft Surface Water Interim Measures/Interim Remedial Action Plan and Decision Document, 903 Pad, Mound, and East Trenches Areas, Operable Unit #2	RCRA/ CERCLA	9-90
Interim Measures/Interim Remedial Action Plan and Decision Document, 903 Pad, Mound, and East Trenches Areas, Median Priority Sites	RCRA/ CERCLA	1-90
Final, Phase II RFI/RI Work Plan (Alluvial), Revision 1, 903 Pad, Mound, and East Trenches Areas, Operable Unit #2	RCRA/ CERCLA	11-90
Draft Final, Phase II RFI/RI Work Plan (Bedrock), Revision 1, 903 Pad, Mound, and East Trenches Areas, Operable Unit #2	RCRA/ CERCLA	1-91
Final Proposed Surface Water Interim Measures/Interim Remedial Action Plan and Decision Document, 903 Pad, Mound, and East Trenches Areas, Operable Unit #2	RCRA/ CERCLA	1-91
Final Proposed Surface Water Interim Measures/Interim Remedial Action Plan/Environmental Assessment and Decision Document for South Walnut Creek Basin, Operable Unit #2	RCRA/ CERCLA	3-91
Final Surface Water IM/IRAP/EA and Decision Document for South Walnut Creek Basin - Public Comment Responsiveness Study 002	RCRA/ CERCLA	3-91
Draft Surface Water IM/IRAP/EA and Decision Document 903 Pad, Mound, and East Trenches Areas OU2	RCRA/ CERCLA	6-90
Preliminary Draft IRAP 903 Pad, Mound, and East Trenches	RCRA/ CERCLA	9-89
Draft RI Plan 903 Pad, Mound, and East Trenches Phase II - Sampling Plan	CERCLA	6-88

1 4 History of Groundwater-Related Activities at the RFP

1 4 1 Activities and Actions

Groundwater monitoring for radionuclide and other constituents has been conducted at the RFP since the first monitoring wells were installed near the Solar Evaporation Ponds in 1960 These wells were installed to investigate leakage of water from the Solar Evaporation Ponds Additional groundwater monitoring wells were added in 1971, 1974, 1980, 1981, and 1982, resulting in a total of 56 wells at the RFP by 1986 These wells were installed to collect groundwater samples and evaluate groundwater quality through analyses of those samples These wells were sampled at least annually until 1974, then twice per year until 1980 when sampling was increased to three times per year Since 1982, monitoring wells have been sampled quarterly Groundwater samples from monitoring wells have always been analyzed for radionuclides and additional chemical constituents were added to the routine analyte list in 1974, 1979, 1981, and 1985 Beginning in 1985, the wells were sampled for volatile organic compounds (VOCs), trace metals, and major ions Major changes in the groundwater monitoring program occurred in 1986, and are discussed in greater detail later in this document

Well-completion details for most wells installed prior to 1986 are not known to exist Those details that were available were included in the Hydrogeologic Characterization of the RFP (Hydro-Search, 1985) Although these early wells provided information on groundwater occurrence and quality, they did not meet the more stringent requirements of RCRA and CERCLA which were implemented at the RFP in 1986 as the result of the 1986 RFP Compliance Agreement (Compliance Agreement, 1986) Signatories to the Compliance Agreement were DOE, CDH, and EPA

One significant requirement of the Compliance Agreement of interest to the GPMPP was completion of Task 3 6, Revised Groundwater Monitoring and Protection Submittal This task required the submittal of a revised, comprehensive groundwater monitoring and protection program for the RFP to address the State and Federal RCRA requirements This task identified the need for an expanded and upgraded groundwater monitoring program

Compliance with the requirements of the Compliance Agreement was to be attained through the implementation of a comprehensive program of site characterizations, remedial investigations (RIs), feasibility studies (FSs), and remedial/corrective actions These actions at the RFP were part of the DOE Comprehensive Environmental Assessment and Response Program (CEARP) (DOE, 1985, 1987a, 1987b) This DOE program was intended to ensure protection of human health and the environment and to implement an environmental mitigation program similar to RCRA/CERCLA

The CEARP program was to identify, assess, and correct existing or potential environmental problems, based on a review of not only RCRA and CERCLA environmental regulations, but also the National Environmental Policy Act (NEPA), Clean Air Act (CAA), Safe Drinking Water Act (SDWA), Toxic Substances Control Act (TSCA), and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) The CEARP program has now been superseded at the RFP by the Environmental Management (EM) Program The intent of both programs is the same

In 1986, an additional 70 monitoring wells were installed to provide a more detailed characterization of the hydrogeology and groundwater quality of the entire RFP and to satisfy RCRA/CERCLA requirements identified in the Compliance Agreement (1986) The work plan for installation, sampling, and analyses of these wells is presented in the Geological and Hydrological Site Characterization Draft Work Plan for the RFP (Rockwell International, 1986b) Initial well installation activities took place at the RFP boundaries and along expected major flow paths near surface drainages which extend beyond the RFP boundaries The initial concern of this program was the identification of groundwater plumes that might extend beyond the RFP boundaries Following installation of the boundary and drainage wells, wells were installed near the 881 Hillside, 903 Pad, Mound, East Trenches, Solar Evaporation Ponds, West Spray Field, and Present Landfill as part of the RFP-wide characterization program to delineate contaminant plumes

An additional 67 wells were installed plant-wide at the RFP in 1987 to characterize groundwater quality and flow at various IHSSs and at RCRA-regulated units The work plans for installation, sampling, and analysis of these wells are presented in the Draft CEARP Phase 2 Installation Generic Monitoring Plan and the Draft CEARP Phase 2 Site-Specific Monitoring Plan (DOE, 1987a and DOE, 1987b)

In 1989, 160 additional wells and piezometers were installed at the RFP to further characterize groundwater quality and flow These installations were specifically related to one or more of the following programs groundwater monitoring requirements at RCRA closure units (Solar Evaporation Ponds, West Spray Field, and Present Landfill), RI/FS CERCLA activities (881 Hillside and 903 Pad, Mound, and East Trenches), background geochemical characterization activities, and/or geologic characterization activities The groundwater monitoring program at each site has been modified as additional site information has been collected and analyzed Public reports prepared for IHSSs and OUs are included in the reference list for this report All groundwater monitoring and characterization activities undertaken since 1986 have been primarily concerned with collection of data necessary to comply with RCRA and CERCLA regulations The location of wells in the groundwater monitoring program at the RFP is provided in Figure 1-3

During 1990, 18 alluvial wells and piezometers were installed at the RFP Thirteen wells and one piezometer were installed in the west Buffer Zone during a new landfill siting investigation (Merrick, 1991) The wells have been developed and will be sampled as part of the groundwater monitoring program starting in 1992

Four piezometers were installed in OU1 as part of the French drain geotechnical investigation (EG&G, 1990a) These wells may be abandoned or removed during the construction of the French drain

1 4 2 Regulatory History and Issues

This section describes the major RFP plans that address groundwater monitoring and identify those documents received from the regulatory agencies that addressed problems with the groundwater monitoring program at the RFP The majority of these documents, both from the RFP and the regulatory agencies, have addressed groundwater monitoring at RCRA-regulated units It should be understood that RCRA groundwater monitoring must meet certain technical requirements (such as technical requirements concerning minimum numbers and placement of monitoring wells) which are identified in the RCRA regulations The CERCLA regulations do not state any specific technical requirements for groundwater monitoring so long as the monitoring system is adequate for site characterization Adequacy of the monitoring systems is reviewed by the lead agency in the workplans and reports required by the IAG Groundwater monitoring at the RFP has consisted of both RCRA and CERCLA programs since 1986, as well as other programs that were and are needed due to overall site characterization needs The groundwater monitoring programs other than the RCRA and CERCLA programs have largely been defined and implemented since 1989

Prior to November 1981, the groundwater monitoring program at the RFP was voluntary and had been implemented and conducted to protect human health and the environment However, in November 1981, the groundwater monitoring program became subject to RCRA regulations Per regulatory requirements, a Groundwater Monitoring Program Plan was submitted to the EPA by DOE in November 1981 (Rockwell International, 1981) This 1981 Plan addressed groundwater monitoring in the Solar Evaporation Pond area, and near the A- and B-series ponds The groundwater monitoring program outlined in this Plan governed groundwater monitoring at the RFP until November 1986

In November 1986, a new groundwater monitoring plan was submitted by DOE for the RFP in Section E of the RCRA Part B Permit Application This groundwater monitoring plan represented a significant change in the groundwater monitoring program at the RFP, and had been required by the 1986 Compliance Agreement signed by EPA, CDH, and DOE This 1986 groundwater monitoring program was supplemented and updated by the submission of an Installation Generic Monitoring Plan (IGMP) and a Site-Specific Monitoring Plan (SSMP) under the DOE CEARP Program in February 1987 (DOE, 1987a, 1987b) Some changes occurred in the groundwater monitoring program in 1987 and early 1988, but the basic program remained essentially unchanged

The groundwater monitoring program was revised in the fall of 1988 These changes in the monitoring program were prompted by the receipt of comments concerning the groundwater monitoring program from CDH on July 19, 1988 These CDH comments concerned RCRA groundwater monitoring and the annual RCRA groundwater monitoring report that had been submitted in the spring of 1988 The revised groundwater monitoring program was submitted to the regulatory agencies in October 1988 as a portion of the RCRA Post Closure Care Permit Application

A Compliance Order was received from CDH on June 7, 1989 Sections of this Compliance Order addressed deficiencies in the RCRA groundwater monitoring program In response to these comments, a RCRA Groundwater Assessment Plan was submitted to CDH in September 1989 (Rockwell International, 1989a) CDH subsequently delivered a Notice of Violation concerning groundwater monitoring and deficiencies identified in the September 1989 Groundwater Assessment Plan on March 28, 1990 (CDH, 1990) In response to these comments the RFP submitted to CDH an Addendum to the Groundwater Assessment Plan in May 1990 (EG&G, 1990b) This Addendum and the

September 1989 Groundwater Assessment Plan still govern RCRA groundwater monitoring at the RFP The CDH provided the RFP comments on the May 1990 Addendum to the Groundwater Assessment Plan and on the 1989 and 1990 Annual RCRA Groundwater Monitoring Reports (EG&G, 1990c and EG&G, 1991a) on September 5, 1991 These comments are under review by the RFP Responses to these comments will either be prepared and submitted to the CDH in a separate document or they will be submitted as a new section of the Annual RCRA Groundwater Monitoring Reports

From 1988 forward, the CERCLA groundwater monitoring programs at the various CERCLA units have largely been identified and defined in the work plans and reports written for each of these units The regulatory agencies and the public are provided the opportunity to review and comment on these documents Beyond the requirements and needs identified in these documents, no overall technical requirements apply to the CERCLA groundwater monitoring conducted at CERCLA-regulated units

The authority for regulatory administration of the groundwater monitoring program rested with the EPA until November 1984 when CDH was delegated interim and final RCRA authorization After that date, CDH has administered a RCRA-equivalent program for the RFP The authority for regulatory administration of any required CERCLA groundwater at the RFP monitoring rests with the EPA

1 4 3 National Enforcement Investigations Center (NEIC) Inspections

During March 31 to April 2, 1987, and from April 6 to April 16, 1987, the EPA's National Enforcement Investigations Center (NEIC), in conjunction with CDH, conducted an inspection of groundwater monitoring activities at the RFP This inspection applied to groundwater monitoring conducted at the RFP from November 1981, until April 1987 The objectives of this inspection (EPA, 1988) were to

"- Determine the facility's compliance with the interim status ground-water monitoring requirements of 40 CFR Part 265 and Part 265 of the Colorado hazardous waste regulations (6 CC 1007-3),

- Evaluate the ground-water monitoring program described in the RCRA Part B permit application submitted by the facility, for compliance with 40 CFR Part 270 14 (c) and Part 100 41(c) of the Colorado hazardous waste regulations (6 CC 1007-3),

- Determine if the ground water at the facility contains hazardous waste and/or hazardous constituents "

The results of this investigation were published by EPA in August 1988 Briefly, the results of this investigation are stated below

- The RFP's 1981 Groundwater Monitoring Program Plan did not comply with the regulatory requirements primarily because

  - sampling and analysis procedures were omitted,

  - a detection monitoring program was instituted at the solar ponds, whereas, a groundwater quality assessment program should have been implemented, and

  - the outline of the required generic groundwater quality assessment program was inadequate because it was essentially a recitation of the regulations

- Although improvements in the groundwater monitoring program had been made since the signing of the Compliance Agreement in 1986, the groundwater monitoring program at the regulated units as proposed in the 1986 RCRA Part B Permit application was still inadequate The primary deficiencies of the 1987 program were

  - the point of compliance had been improperly located and did not comply with the regulations,

  - the monitoring program at the solar ponds was inadequate because releases had been detected at that unit and the unit should not have been in a detection monitoring program,

- construction documentation for new wells was found to be inadequate, contradictory, incomplete, or inaccurate,
- the rationale presented of the selection of monitoring parameters was deficient, and
- improvements were required in sampling and analysis procedures

- Hazardous constituents were present in the groundwater at the Solar Evaporation Ponds (now designated OU4) and at 881 Hillside (now designated OU1)

The results of this investigation and the comments received from CDH were considered in revising the groundwater monitoring program in the fall of 1988 for the RCRA Post-Closure Care Permit Application This permit application and the procedures outlined in it were superseded by the requirements of the IAG and the documents required by this Agreement

ROCKY FLATS PLANT GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN	Manual No Procedure No Effective Date Organization	21000-MP-GPMP 2 0, Rev 0 2/15/92 Environmental Management

Background

Approved by Michael G. Flook 4/15/92

Project Manager Date

Reviewed for Classification /UCNI

By George H. Setlock

Date 11/21/91 UNU

2.0 BACKGROUND

2.1 Geology

The RFP is located four miles east of the Front Range section of the Southern Rocky Mountain province and along the western margin of the Colorado Piedmont section of the Great Plains physiographic province (Spencer, 1961) The RFP is located on a pediment that dips approximately one degree to the east and is dissected by several small streams that flow eastward with their headwaters either on the RFP, or one to two miles to the west of the RFP

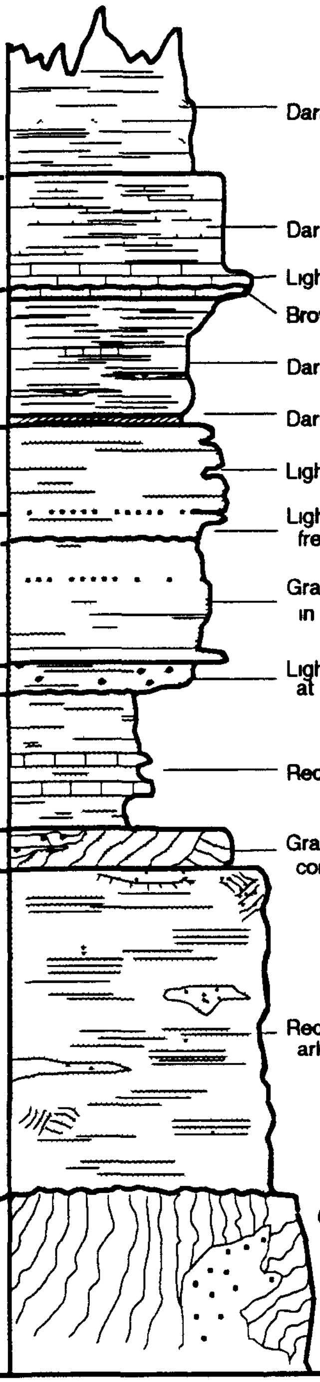
2.1.1 Stratigraphy

The stratigraphic model is based upon the RFP Draft Final Geologic Characterization Report (EG&G, 1991b) and researched and published information The model will be evaluated with additional data produced from current and future studies The stratigraphic section in the vicinity of the RFP extends from the Precambrian to the Quaternary Figure 2-1 depicts a generalized stratigraphic section of the area, whereas, Figure 2-2 illustrates a site-specific stratigraphic section of the geology beneath the RFP West of the plant, rocks from the Pennsylvanian/Permian to Late Cretaceous age are exposed along the western limb of a prominent monoclinal fold The strata are progressively older toward the west, with the Fountain Formation resting unconformably on Precambrian rocks of the Front Range

The Pierre Shale, Fox Hills Sandstone, Laramie Formation, and Arapahoe Formation, which comprise the uppermost portion of the bedrock stratigraphic section, represent a progradational fluvial-deltaic-marine sequence The general stratigraphic and facies relationships are depicted in Figures 2-3 and 2-4 and are summarized in Table 2-1 For

Age	Formations	Thickness (feet)	Summary Description
TERTIARY	Green Mt. Conglomerate	600	Boulder conglomerate with occasional thin siltstone lenses
TERTIARY	Denver Arapahoe Fm	1200	Tan sandy claystone and clayey sandstone conglomerate at base, includes Table Mountain andesite to the north
UPPER CRETACEOUS	Laramie Fm	1000	Gray, fine- to medium-grained sandstone & silty claystones, thin coal beds at bottom
UPPER CRETACEOUS	Fox Hills Fm.	75	Tan fine- to medium-grained sandstone and sandy shale
UPPER CRETACEOUS	Pierre Fm	8000	Dark gray silty shale and fine thin silty sandstone
UPPER CRETACEOUS	Niobrara Fm.	350	Dark gray very calcareous shale Foraminifera abundant (Smoky Hill Member) Light gray dense fossiliferous limestone (Fort Hays Member)
UPPER CRETACEOUS	Benton Fm	420	Brown sandy fossiliferous limestone Dark gray shale with bentonite streaks thin limestones in middle part Dark gray, brittle silty shale (Mowry)
LOWER CRETACEOUS	Dakota Group: South Platte Fm	270	Light gray fine- to medium-grained sandstone several dark gray shales in middle
LOWER CRETACEOUS	Dakota Group: Lytle Fm	100	Light gray fine- to coarse-grained locally conglomeratic sandstone, frequent red and green siltstone interbeds
JURASSIC	Morrison Fm	365	Gray to greenish-gray to red shale and sandstone, thin limestones in middle part lenticular sandstones in upper and lower part
JURASSIC	Ralston Creek Fm	110	Light tan siltstone and light red silty shale Gypsiferous sandstone at base and locally conglomeratic
TRIASSIC?	Lykins Fm	400	Red siltstone with two laminated limestones in lower part
PERMIAN	Lyons Fm	120	Grayish white fine- to medium-grained cross-bedded sandstone conglomeratic lenses frequent
PENNSYLVANIAN	Fountain Fm	1000	Red fine- to coarse-grained sandstones and conglomerates, arkosic thin lenticular red siltstones frequent throughout
	PRECAMBRIAN		Gniess schist, and small granitic inclusions Exposed at mouth of Mt. Vernon Canyon

Graphic Section



Modified from LeRoy & Weimer, 1971 and Weimer, 1973

GENERALIZED STRATIGRAPHIC SECTION, GOLDEN-MORRISON AREA

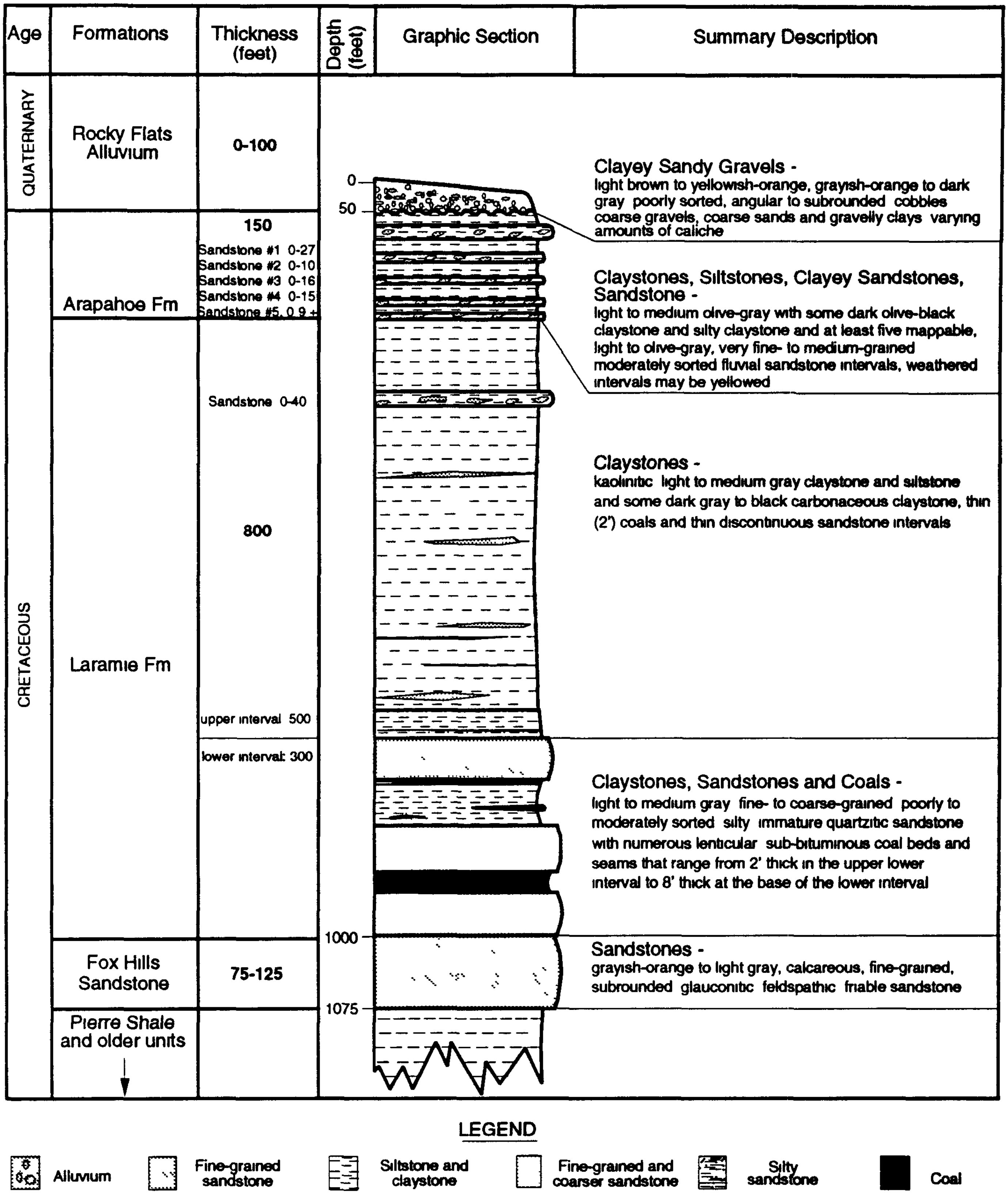
GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

EG&G

Rocky Flats Plant, Golden, Colorado

FIGURE 2-1

STRATCOL.DRW



GENERALIZED STRATIGRAPHIC SECTION, ROCKY FLATS PLANT

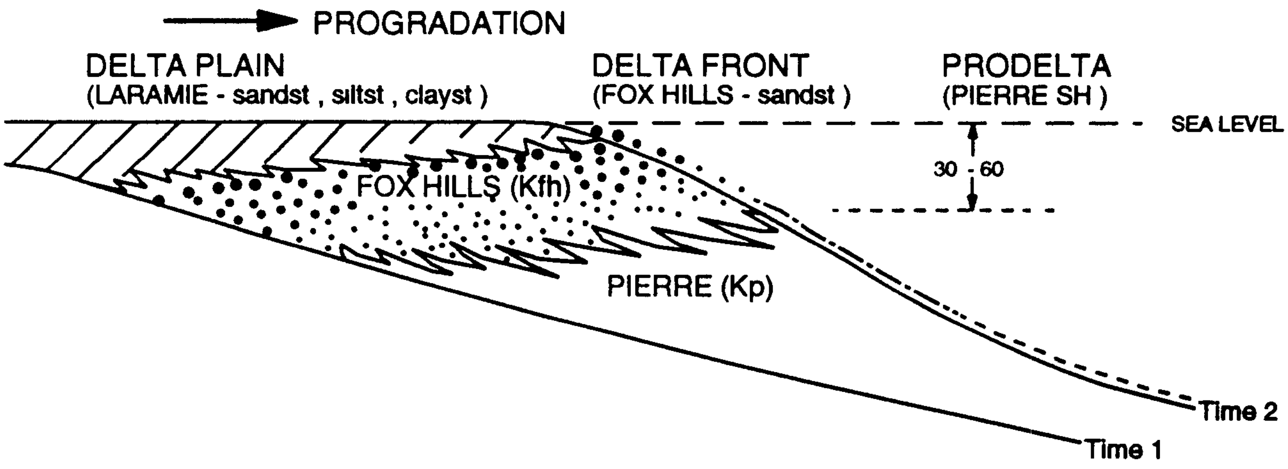
GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

EG&G

Rocky Flats Plant, Golden, Colorado

FIGURE 2-2

LOCSTRAT.DRW



After Weimer 1976

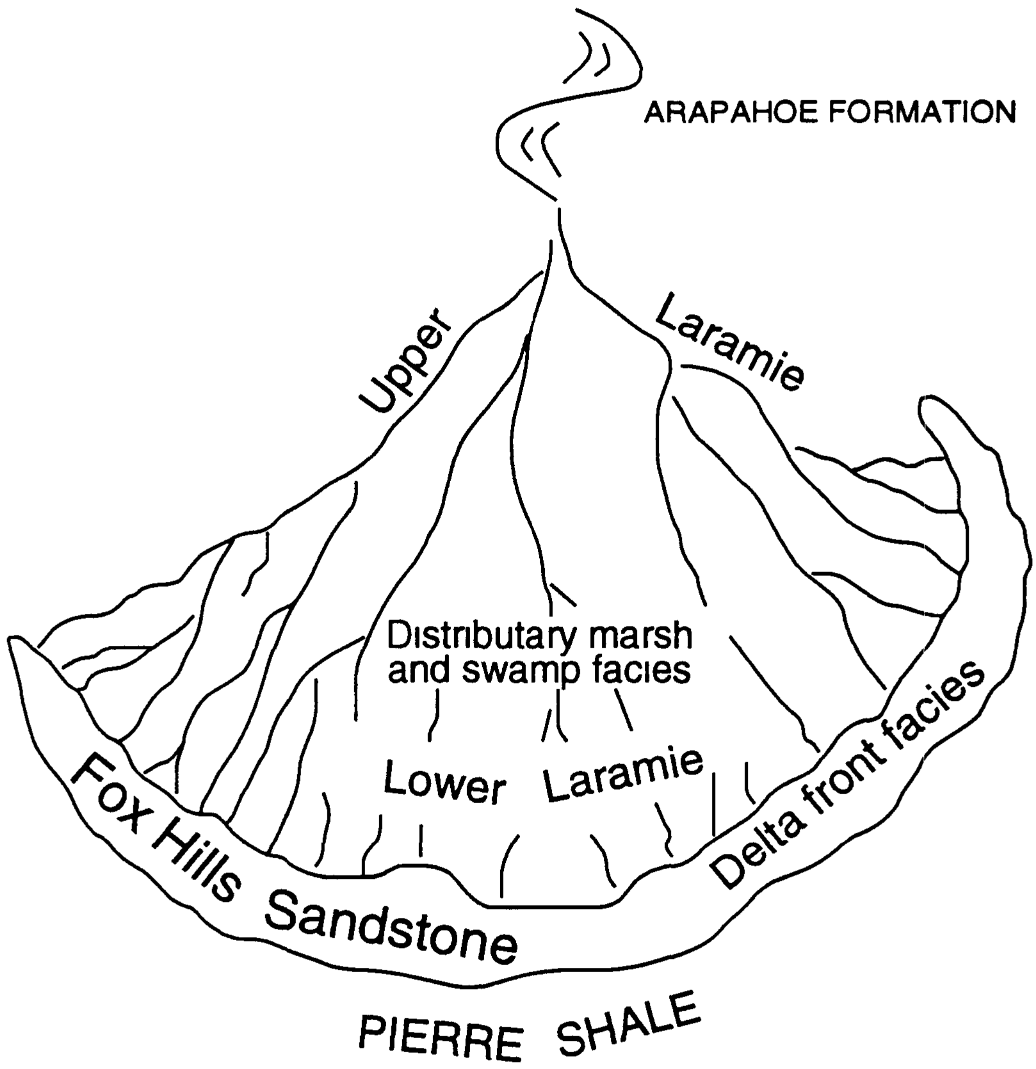
DELTA SEDIMENTATION MODEL RELATING FORMATIONS TO FACIES AND TO ENVIRONMENTS OF DEPOSITION

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

EG&G

Rocky Flats Plant, Golden, Colorado

FIGURE 2-3



Modified from Weimer 1976

IDEALIZED MODEL OF DELTAIC SYSTEM FOR THE LARAMIE, FOX HILLS, AND PIERRE FORMATIONS

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

EG&G

Rocky Flats Plant, Golden, Colorado

FIGURE 2-4

DELTASYS.DRW

Table 2-1

Summary of Formations at Rocky Flats Plant

Formation	Approximate Thickness	Facies
Rocky Flats Alluvium	Absent - 100'	Alluvial Fan
Arapahoe Formation	150'	Fluvial (meanders at top, braided at base)
Laramie Formation	800'	Deltaic (Distributary and paludal)
Fox Hills Sandstone	75'- 125'	Delta - Front
Pierre Shale	>8,000'	Marine

Source EG&G, 1991b

clarification, these Upper Cretaceous formations and the overlying Quaternary Rocky Flats Alluvium and Recent colluvial and alluvial deposits are described briefly below.

Pierre Shale (Upper Cretaceous)

The Pierre Shale is over 8,000 feet (ft) thick and is predominantly a medium to dark gray, non-calcareous shale It contains fossils, including foraminifera and an ammonite, *Baculites clinolobatus*, which indicate that the formation was deposited in a marine environment (Weimer, 1973) The contact between the Pierre Shale and the Fox Hills Sandstone is complex because it represents the transition between marine and continental disposition

Fox Hills Sandstone (Upper Cretaceous)

The Fox Hills Sandstone is 75 to 125 ft thick and is a grayish-orange to light gray color. The dominant lithology is a calcareous, fine-grained, subrounded, friable, glauconitic, feldspathic sandstone with thin beds of siltstone and claystone Weimer (1976) interpreted the formation as a delta-front sandstone in facies relationship with the underlying Pierre Shale and the overlying Laramie Formation (Figures 2-3 and 2-4)

Laramie Formation (Upper Cretaceous)

The Laramie Formation is about 800 ft thick and is composed of two intervals: a lower 300 ft sandstone and coal interval and a 500 ft upper claystone interval The sandstones are light to medium gray, fine- to coarse-grained, poorly sorted, subangular, silty, quartzitic, and containing grains of black chert Clay, mica, and carbonaceous material are also present (Van Horn, 1957, Weimer, 1976). The claystones are dominantly light to medium gray and kaolinitic, however, dark gray to black carbonaceous claystones are also present (Van Horn, 1957, Weimer, 1976)

Arapahoe Formation (Upper Cretaceous)

The Arapahoe Formation is the uppermost bedrock unit underlying the RFP and, therefore, more site-specific information is available for the Arapahoe Formation than any of the deeper formations Unless otherwise noted, descriptions provided in this report are the result of the RFP's ongoing geologic characterization efforts

The Arapahoe Formation is approximately 150 ft thick in the central portion of the RFP and consists mainly of claystones and silty claystones In addition, it contains at least five mappable sandstone intervals Due to the lenticular geometries of the sandstones, they are not present in all of the boreholes or areas beneath the plant The sandstones and stratigraphic distances between them are given in Table 2-2.

Most of the Arapahoe sandstones are poorly to moderately sorted, subangular to subrounded, silty, clayey, and quartzitic, and very fine- to medium-grained, however, some are coarse-grained to conglomeratic Trough and planar cross-stratification are common sedimentary structures The median sandstone grain size (D50 value) ranges from 0 06 to 0 09 mm Commonly, the Arapahoe sandstones occurring within 30 to 40 ft of the base of the alluvium are oxidized and are pale orange, yellowish-gray, and dark yellowish-orange The sandstones that are not in the weathered zone are light gray and olive gray

The claystones and silty claystones are light to medium olive gray In the weathered intervals below the base of the alluvium, claystones are sometimes dark yellowish-orange and yellowish-brown as the result of iron-oxide staining

Table 2-2

Arapahoe Sandstones: Thickness and Vertical Separation

Sandstone	Thickness (ft)	Approximate Vertical Separation between Sandstones, Depending on Sandstone Thickness
Sandstone #1	Absent - 28'	
		35' - 40'
Sandstone #2	Absent - 10'	
		15'- 23'
Sandstone #3	Absent - 16'	
		7' - 18'
Sandstone #4	Absent - 15	
		2' - 8'
Sandstone #5	Absent - 9'+	

Source EG&G, 1991b

Rocky Flats Alluvium (Quaternary)

The Rocky Flats Alluvium is a gravelly pediment cover of Nebraskan or Aftonian age (Scott, 1975) This alluvial fan deposit ranges up to 100 ft in thickness and occurs about 250 ft to 380 ft above modern streams (Scott, 1965) It is composed of poorly sorted, angular to rounded, coarse gravel, sand, and gravelly clays Caliche amounts vary from trace to abundant Colors of the Rocky Flats Alluvium include light brown to dark yellowish-orange, grayish-orange, and dark gray

Colluvial and Alluvial Deposits (Recent)

Colluvial deposits commonly contain a thin soil with occasional mixed composition which results from mass-wasting along valley slopes The dominant texture is silty clay and clayey silt with some gravel and sand The Valley Fill alluvial deposits are represented by poor to well graded mixtures of reworked Rocky Flats Alluvium, colluvium, and weathered bedrock found in drainages throughout the area. Both of these types of deposits range from only a few inches to tens of feet in thickness.

2 1 2 Structure and Tectonics

Structurally the RFP is located along the western margin of the Denver Basin, an asymmetric downwarp possessing a steeply dipping western flank and a broad gentle eastern flank The Front Range uplift, approximately four miles west of Rocky Flats, is the most easterly range of mountains in the Southern Rocky Mountain province. Its structural history is complex, and interpretations regarding structural styles and the sequence of events are varied

The Laramide Orogeny, which occurred from approximately 67 5 to 45 million years (m y) ago, produced large scale Front Range deformation In a period of 1 5 m y , uplift and erosion resulted in the removal of 3,000 ft of sedimentary rocks and exposure of the Precambrian core (Tweto, 1975) Recent investigations of the Front Range Laramide tectonic structures suggest that the Laramide uplifts are bounded by thrust faults which dip at rates of 22 to 35 degrees beneath the uplifts (Bieber, 1983 and Gries, 1983.)

Figure 2-5 is a generalized east-west structural cross section of the RFP. The most conspicuous structural feature of the Rocky Flats area is a monoclinal fold, which formed west of the plant during the Laramide Orogeny According to Tweto (1975), the fold developed at the juncture where sedimentary rocks contact the Front Range border thrust During the Miocene and Pliocene, the fold was probably modified by additional faulting The axial plane of the fold strikes roughly north-south and plunges at approximately 58 degrees to the west near borehole 52-86 in the West Spray Field (EG&G, 1991b)

The west limb of the monoclinal fold is comprised of strata which dip to the east at roughly 50 degrees In contrast, strata forming the east limb of the fold dip 1 to 2 degrees to the east Along the west limb of the fold an angular discordance exists between the Late Cretaceous section and the base of the Quaternary Rocky Flats Alluvium (EG&G, 1991b)

No active faults are known to exist along the Front Range in the area from Golden to Boulder, Colorado (Figure 2-6) The Eggleston fault, which was mapped by Spencer (1961) and later projected onto the RFP (Hurr, 1976) was investigated in great detail in 1981 and is now believed not to exist at the RFP (Dames and Moore, 1981) A thrust fault with a maximum throw of about 80 ft at a depth of approximately 3,600 ft has been mapped in the Pierre Shale directly beneath the RFP (Figure 2-7) This fault was identified in reprocessed seismic data originally acquired in 1975-1976 by the Geophysics Department at the Colorado School of Mines and later reprocessed and evaluated by the

Background

Approved by

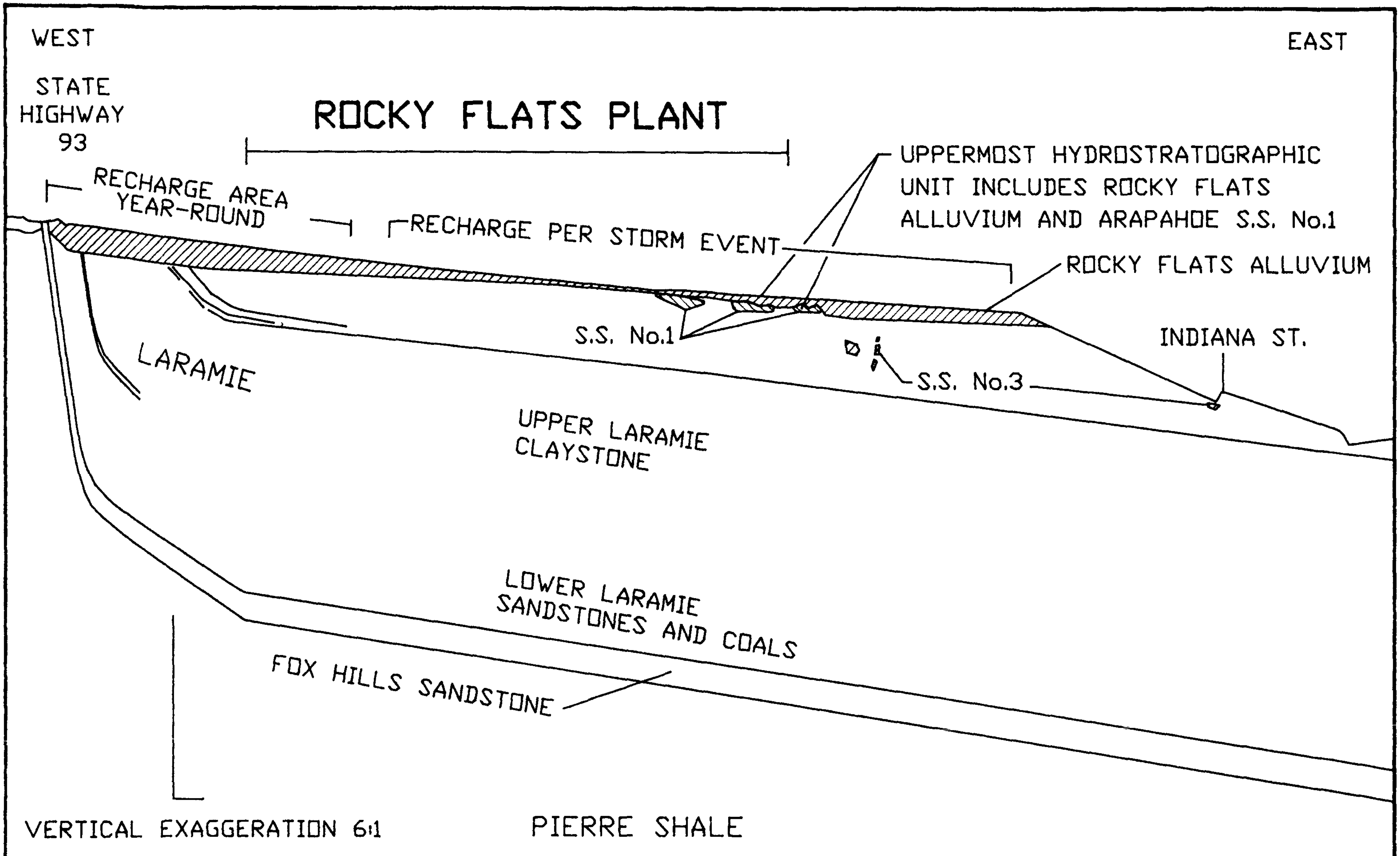
J. W. Langman   2/18/92

Project Manager   Date

Reviewed for Classification /UCNI

By George H. Setlock

Date 11/21/91 UNU

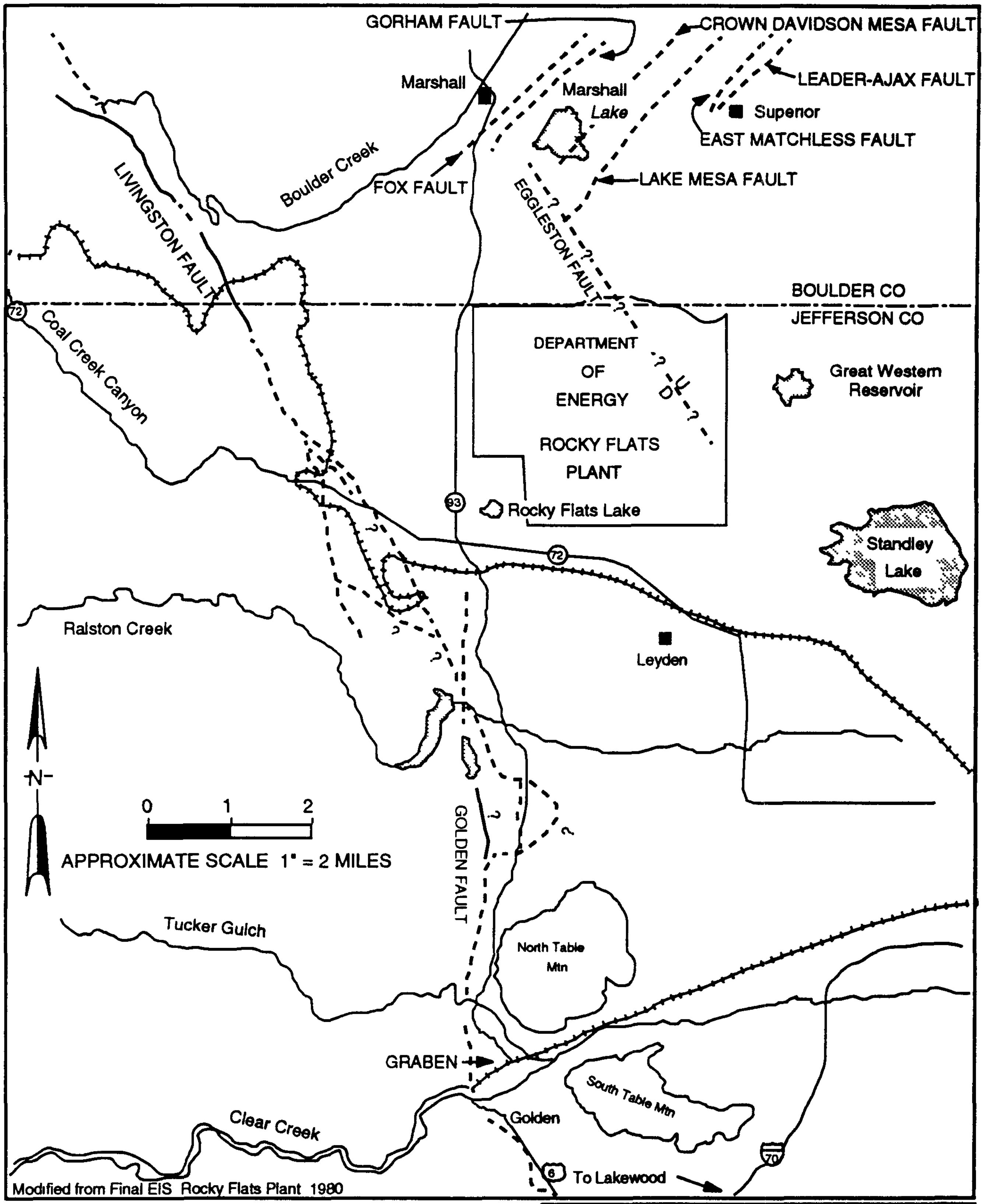


WEST TO EAST STRUCTURAL CROSS SECTION

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

EG&G FIGURE 2-5

Rocky Flats Plant, Golden, Colorado



LOCATIONS OF FAULTS BETWEEN GOLDEN AND MARSHALL, COLORADO

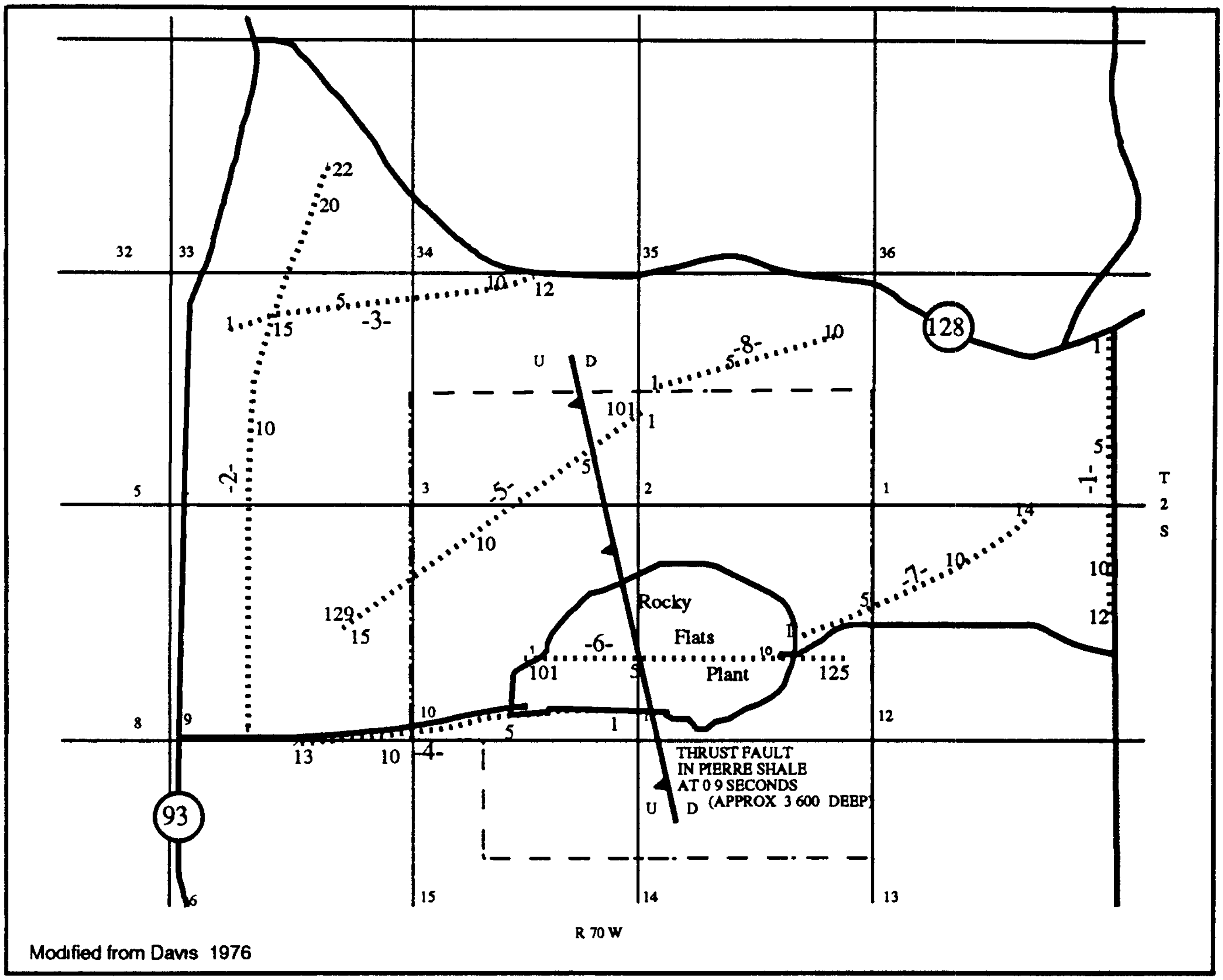
GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

EG&G

Rocky Flats Plant, Golden, Colorado

FIGURE 2-6

FAULT2 DRW



0 2,000 4,000

APPROXIMATE SCALE 1" = 4,000'

LEGEND

- .... 1975-1976 COLORADO SCHOOL OF MINES SEISMIC LINES
- THRUST FAULT
- -4- LINE NUMBER
- 15 SHOT POINTS

-N-

LARAMIDE THRUST BENEATH ROCKY FLATS PLANT

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

EG&G

Rocky Flats Plant, Golden, Colorado

FIGURE 2-7

THRUST DRW

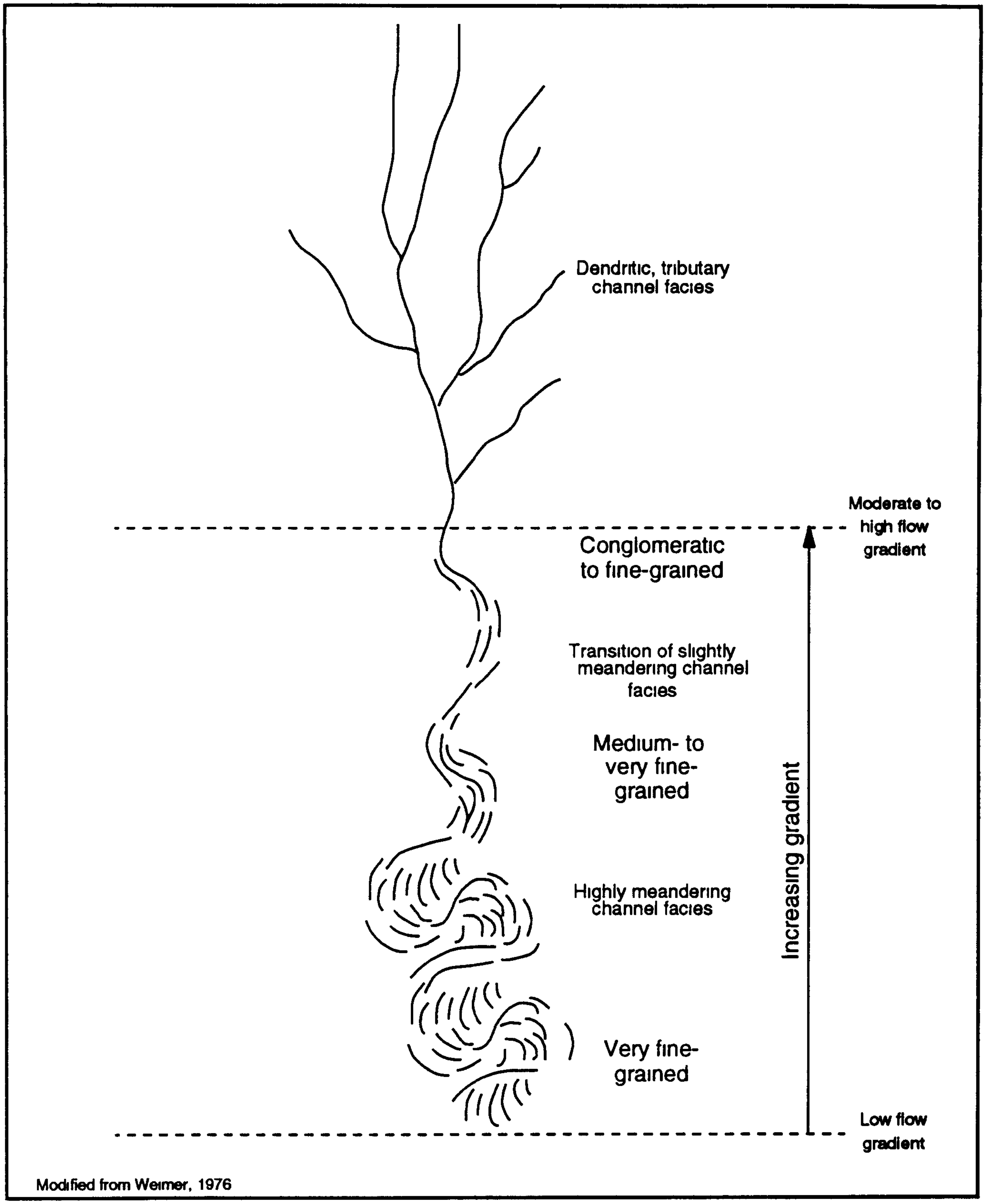
RFP in the Draft Geologic Characterization Report (EG&G, 1990d). The thrust formed over 45 m y ago during the Laramide Orogeny and is no longer active (EG&G, 1990d).

Fractures related to the development of the extensive folding and faulting along the Front Range are generally healed and exhibit slickensides when the rock is broken. The current sitewide drilling program for the Phase II Geologic Characterization has encountered intervals in the bedrock that have open fractures Further investigation of the current and past data is needed to determine the extent and nature of these fractures.

2 1 3 Depositional Model - Arapahoe Formation

The Arapahoe Formation is a fluvial deposit composed of channel, point-bar, and overbank deposits Figure 2-8 presents an idealized model of the fluvial system for the Arapahoe Formation, in which the channel geometries of the Arapahoe sandstones beneath the RFP are variable Most of the sandstones of the Arapahoe Formation at the RFP are very fine- to medium-grained and represent deposition from meandering streams Occasional conglomeratic sandstones have been documented and represent higher energy flow regime conditions In contrast, the Arapahoe Formation south of the RFP near Golden is coarser-grained and appears to represent braided stream deposits Figure 2-9 shows the sequence of events believed to have occurred from upper Laramie through Arapahoe deposition

Figures 2-10 and 2-11 present two interpretations for the Arapahoe Sandstone No. 1 as set forth in the Draft Final Geologic Characterization Report, July 31, 1991 (EG&G, 1991b) and which are based on correlations, core descriptions, and high resolution seismic data (EG&G, 1991c) Both interpretations support the idea that Sandstone No 1 was deposited by meandering streams The first interpretation shows a continuous single channel system Channel and point-bar deposits are both recognized, however, channel fill deposits are dominant The second interpretation depicts a multiple channel



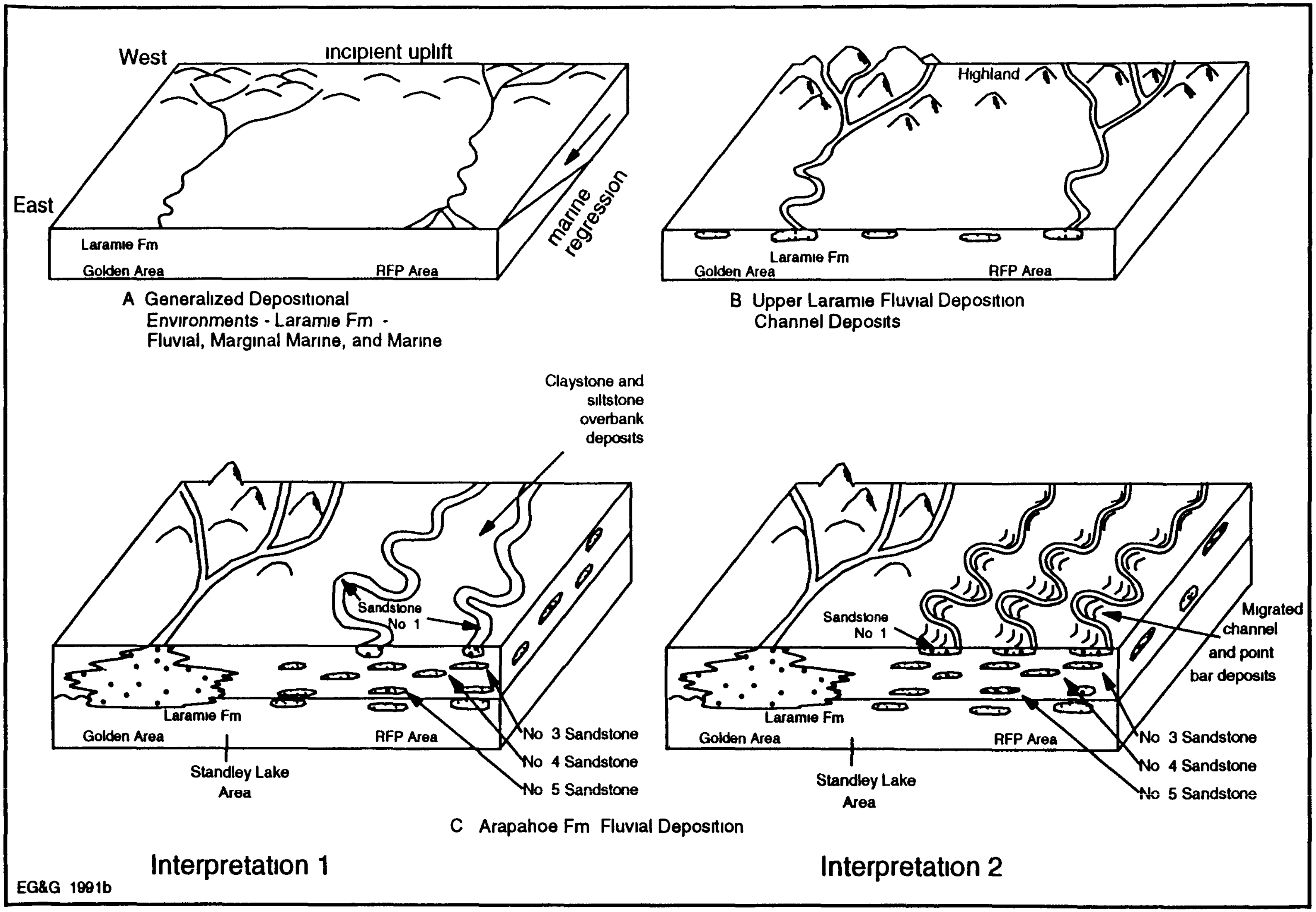
IDEALIZED MODEL OF FLUVIAL SYSTEM FOR THE ARAPAHOE FORMATION

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

EG&G

Rocky Flats Plant, Golden, Colorado

FIGURE 2-8



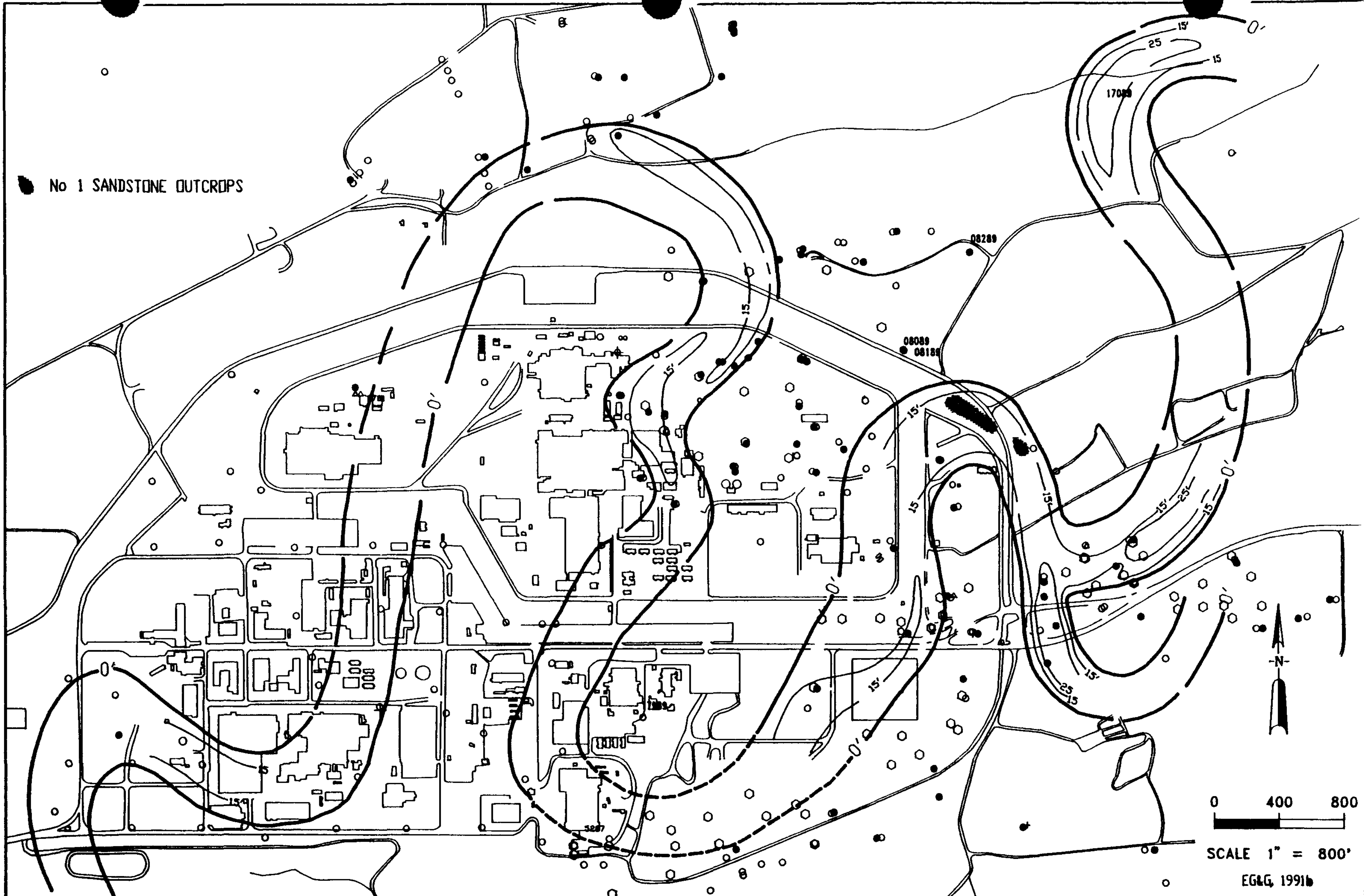
SEQUENCE OF EVENTS: END OF LARAMIE DEPOSITION THROUGH ARAPAHOE DEPOSITION

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

EG&G

Rocky Flats Plant, Golden, Colorado

FIGURE 2-9

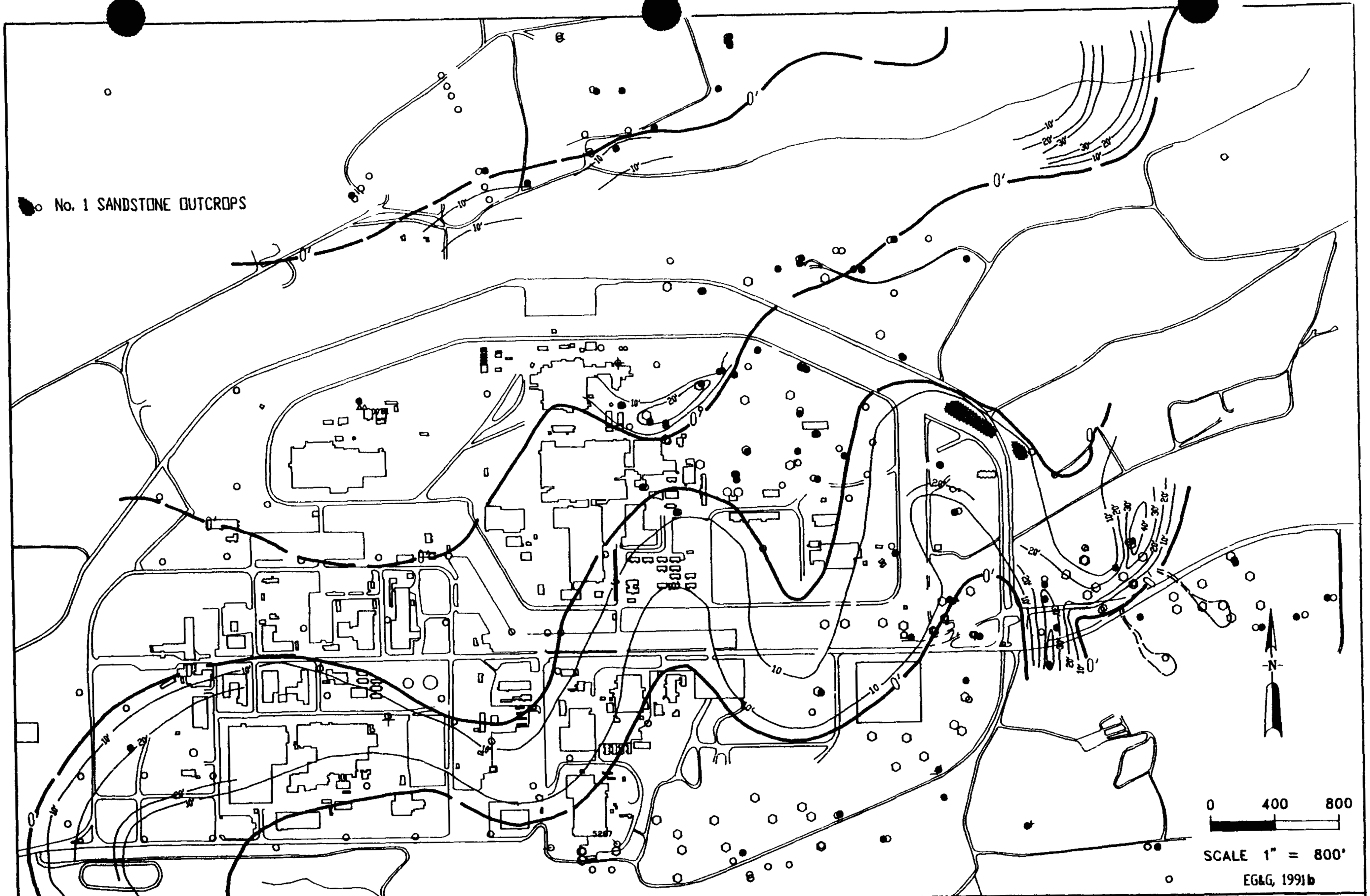


GENERALIZED ISOPACH OF ARAPAHOE SANDSTONE NO. 1
INTERPRETATION 1

GROUNDWATER PROTECTION
AND MONITORING PROGRAM PLAN

EG&G FIGURE 2-10

Rocky Flats Plant, Golden, Colorado



GENERALIZED ISOPACH OF ARAPAHOE SANDSTONE NO. 1
INTERPRETATION 2

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

EG&G FIGURE 2-11

Rocky Flats Plant, Golden, Colorado

system containing migrated channel and point-bar deposits In either interpretation, a minimum of three fining upward sequences can be recognized in boreholes where penetration of Sandstone No 1 is complete It is also possible that individual sandstones have lenticular geometries and may not be in hydraulic communication with one another. Overbank deposits of lower permeability are known to separate the sandstones in subsurface cores

2.2 Hydrogeology

2 2 1 Introduction

The RFP is located in a regional groundwater recharge area (EG&G, 1991b). Groundwater recharge occurs as infiltration of precipitation, primarily where bedrock crops out in the western portion of the RFP, along the west limb of the monoclinal fold (Figure 2-5) Recharge also occurs as a result of seepage from steams, ditches, and ponds At the local level, there are areas of discharge as well as recharge Groundwater discharges in streams and along slopes as seeps Much of the groundwater within the uppermost hydrostratigraphic unit becomes surface water or evaporates as it is discharged from the groundwater system at seeps along slopes and in drainage valleys

2 2 2 Hydrostratigraphic Units

Several hydrostratigraphic units exist at the RFP within the Arapahoe Formation and the overlying unconsolidated materials The uppermost hydrostratigraphic unit exists as a water table (unconfined) aquifer The lower hydrostratigraphic units exist as confined aquifers

The water-table (unconfined) aquifer at the RFP is primarily the unconsolidated alluvial material It includes the Rocky Flats Alluvium, which is present on broad topographic highs, colluvium along valley slopes, and the Valley Fill Alluvium present in modern stream drainages In the western part of the RFP, where the thickness of the alluvial material is greatest, the depth to the water table is 50 to 70 ft below the surface. Although the water table depth is variable, it becomes shallower from west to east as the alluvial material thins In the stream drainages, seeps are common at the base of the Rocky Flats Alluvium at the contact with claystones of the Arapahoe Formation and Laramie Formation and where individual Arapahoe Formation sandstones crop out.

Generally, the groundwater flows along the contact of the unconsolidated material and the Arapahoe Formation claystones in a downgradient direction to the east The claystones have a low hydraulic conductivity, on the order of 1×10^{-7} centimeters per second (cm/s), effectively constraining much of the flow within the water table aquifer to the alluvial material above the alluvium/bedrock unconformity

Groundwater in the sandstone units of the Arapahoe Formation occurs under confined conditions over most of the Plant site area The exception to this is the occurrence of groundwater in the Arapahoe Formation sandstone units where they subcrop beneath the alluvial material In this situation, there is a hydraulic connection between the bedrock and the alluvial material allowing the bedrock groundwater to exist under unconfined conditions, as part of the alluvial aquifer Arapahoe Sandstone No 1 subcrops frequently throughout the RFP area and therefore, is part of the unconfined aquifer for a substantial portion of its occurrence The lower sandstones of the Arapahoe Formation also subcrop beneath alluvium and colluvium but in limited areas in the valleys and along valley slopes.

Subcropping Arapahoe Formation sandstones and the alluvial material form the uppermost hydrostratigraphic unit at the RFP A water level map of this hydrostratigraphic unit is presented as Figure 2-12 (EG&G, 1991b) This water level map was created from water levels measured in wells during the month of April 1990 The wells do not uniformly penetrate either the alluvial material or the subcropping sandstone and therefore a true potentiometric surface of the water table cannot be generated. Instead, the measured water levels are used to represent the water table during the period of measurement for the uppermost hydrostratigraphic unit

Arapahoe Sandstones Nos 2, 3, 4 and 5 exist for the most part as confined aquifers at the RFP The confining layers for the sandstones are the claystones and silty claystones of the Arapahoe Formation

2 2 3 Hydraulic Conductivities

The Arapahoe and the alluvial hydrostratigraphic units at the RFP have relatively low hydraulic conductivities and therefore, are not generally believed to be capable of producing economical amounts of water Hydraulic conductivity values are based on packer tests performed in 1986 and 1989 The following hydraulic conductivities are for the purposes of comparison only and are not meant to be used in statistical calculations.

No conclusive data are available for the Recent alluvial and colluvial deposits, however the Rocky Flats Alluvium of the uppermost hydrostratigraphic unit has a hydraulic conductivity of roughly $6x10^{-5}$ cm/sec (60 ft/yr) in Well 1-89 This value is comparable to the hydraulic conductivity of $8x10^{-5}$ cm/sec (80 ft/yr) for the highly weathered and unconsolidated subcropping Arapahoe sandstone which also forms a part of the uppermost hydrostratigraphic unit in Well 3-86 Both of these values are much greater than the hydraulic conductivities of the Arapahoe claystones which are approximately 10^{-7} to 10^{-8} cm/sec (0 1 to 0 01 ft/yr) for both weathered and unweathered claystone. In the stream drainages surrounding the RFP, a similar alluvium/bedrock scenario exists for the uppermost aquifer, except it involves colluvium and valley fill alluvium overlying the lower Arapahoe Sandstones Nos 3, 4, and 5

In the subsurface, confined hydrostratigraphic units in the Arapahoe Sandstones Nos. 3, 4, and 5 have hydraulic conductivities of approximately 10^{-6} cm/sec (1 ft/yr) This value is intermediate to that of the hydrostratigraphic units in the Rocky Flats Alluvium and weathered subcropping Arapahoe sandstones (10^{-5} cm/sec or 60 to 80 ft/yr) and the Arapahoe claystones (10^{-7} to 10^{-8} cm/sec or 0 1 to 0 01 ft/yr)

The Laramie/Fox Hills aquifer crops out at the west end of the RFP and dips at 45 to 50 degrees to the east Gradually the dip decreases to less than 2 degrees beneath the central part of the RFP where the Laramie/Fox Hills is separated from the RFP activities by several hundred ft of claystone (Hurr, 1976 and EG&G, 1990d) (Figures 2-3 and 2-4) The claystone is an aquitard which restricts the RFP activities from affecting the Laramie/Fox Hills aquifer

2 3 Groundwater Monitoring

2 3 1 Current Monitoring Well Network

Groundwater monitoring has been conducted at the RFP since the first groundwater monitoring wells were installed in 1960 In July 1986, when RCRA requirements were first applied to mixed wastes at the RFP (Compliance Agreement, 1986), a total of 56 wells existed An additional 70 wells were completed in 1986 These were needed to characterize the hydrogeology and groundwater quality of the RFP and to satisfy requirements outlined in the compliance agreement In 1987, 67 additional wells were completed in an effort to characterize the groundwater quality and flow directions at various IHSSs and at RCRA or CERCLA units No wells were installed during 1988

One hundred sixty wells and piezometers were installed during 1989, and 18 wells and piezometers were installed in 1990, bringing the total well count for the groundwater monitoring program to 371 The 1989 wells were installed to provide data for RCRA closure units, remedial and feasibility studies for OUs, background geochemical studies; and the geologic characterization project The 1990 wells were installed as part of on-going characterization work at OU1 and in conjunction with a landfill siting study

The wells in the current program are distributed throughout the buffer zone, as well as within the controlled area Figure 1-3 represents all the wells within the current groundwater network, and includes those wells being sampled and analyzed for specific constituents

Well Construction

Pre-1986 Wells

Fifty-six monitoring wells were installed during the period of 1960 to 1982. Unfortunately, there is very little well-completion information available for these wells, therefore, all of the pre-1986 wells are scheduled for abandonment beginning in fiscal year 1992 (see Section 4 3) Table E-1 of the Resource Conservation and Recovery Act Post-Closure Care permit Application (Rockwell International, 1986c) clearly indicates that the well-construction details of the pre-1986 wells are unknown

1986 Wells

During 1986, a total of 53 alluvial and 17 bedrock wells were installed The wells were constructed with two-inch diameter, 316 grade stainless steel casing, and wire-wrapped stainless steel screen with a 0 020- or 0 010-inch opening Grade 12-20 Colorado Silica Sand was used to fill the annulus between the well casing and the borehole walls when using the 0 020-inch opening screen, while grade 16-40 or 32-42 Colorado Silica Sand was used with the 0 010-inch screen No sumps were installed below the screen.

Screens were cut to length and welded to the solid riser casing (Rockwell International, 1986d)

The alluvial wells were screened five ft above the static water level encountered at the time of drilling This was done to allow for seasonal variations in the water table In both alluvial and bedrock wells, the sand pack was extended approximately two ft above the screened interval A bentonite pellet seal a minimum of one ft thick, was placed above the sandpack, and the annular space above the bentonite seal was cemented to the ground surface with cement grout containing five percent bentonite. A steel protective casing with a locking cover was installed immediately subsequent to well installation. A concrete surface pad designed to deflect surface water away from the well was installed within two weeks following grouting operations (Rockwell International, 1986d)

Forty-one of the 70 monitoring wells installed in 1986 are currently being sampled The remainder of these wells, which have been damaged and are not suitable for sampling, are currently being evaluated for replacement or abandonment

1987 Wells

During 1987, 43 alluvial wells and 24 bedrock wells were installed. The wells were constructed of two-inch diameter, 316 grade, stainless steel casing, and wire wrapped stainless steel screen with a 0 010-inch opening Grade 32-42 Colorado Silica Sand was used to fill the annulus between the well casing and the borehole wall All screen was custom cut and welded to the solid riser casing No sumps were installed below the screen Well design and drilling methods were consistent with those used during well installation in 1986 (DOE, 1987c)

1989 Wells

Dunng 1989, 112 alluvial wells and 48 bedrock wells were installed The alluvial wells were constructed of four-inch diameter schedule 40 polyvinylchlonde (PVC), while the piezometers and bedrock wells shallower than 100 ft were constructed of two-inch diameter schedule 40 PVC Bedrock wells deeper than 100 ft were constructed of two-inch schedule 80 PVC Using PVC resulted in reduced well installation costs and allowed increased well casing diameter to facilitate sampling Both alluvial and bedrock wells were constructed with 0 010-inch screens Grade 16-40 Colorado Silica Sand was used to fill the annulus between the well casing and the borehole wall One-foot sumps were installed below the screen, and all casing and screen were threaded flush joint Well design and drilling methods were consistent with those used dunng well installation in 1986 and 1987 (Rockwell International, 1987)

1990 Wells

Dunng 1990, 16 alluvial wells and piezometers and two alluvial/bedrock piezometers were installed Of these 18 well and piezometers, 13 alluvial wells and one alluvial piezometer were installed dunng the landfill siting investigation These 14 wells/piezometers were completed with 2-inch diameter schedule 40 PVC casing and 0 010-inch screens Three of the 14 wells were installed with 16-40 grade filter packs and eleven were installed with 8-12 grade filter packs with pre-pack 16-40 sand (Mernck, 1991)

Four French drain geotechnical investigation piezometers were installed Two were installed with 2-inch diameter schedule 40 PVC casing and two were installed with 2-inch diameter schedule 80 PVC casing with 0 010-inch screens and 16-40 grade filter packs (EG&G, 1990a) A summary of well constructions from 1986 through 1990 is listed in Table 2-3

Table 2-3

Summary of Well Design from 1986-1990

Installation Year	Casing Type	Screen Opening (in)	Sandpack USGS Sieve Size
1986 Alluvial	2 inch 316 SS	0.010 0 020	16 - 40 32 - 42 12 - 20
1986 Bedrock	2 inch 316 SS	0 010 0 020	16 - 40 32 - 42 12 - 20
1987 Alluvial	2 inch 316 SS	0 010	32 - 42
1987 Bedrock	2 inch 316 SS	0 010	32 - 42
1989 Alluvial	4 inch SCH 40 PVC*	0 010	32 - 42
1989 Piezometer	2 inch SCH 40 PVC*	0 010	32 - 42
1989 Shallow Bedrock	2 inch SCH 40 PVC*	0 010	32 - 42
1989 Deep Bedrock	2 inch SCH 40 PVC*	0 010	32 - 42
1990 Landfill Siting	2 inch SCH 40 PVC**	0 010	16 - 40 8 -12 with Pre-pack 16 - 40
1990 French Drain	2 inch SCH 40 PVC*** 2 inch SCH 80 PVC***	0 010	16 - 40

Notes SS = Stainless Steel
SCH 20 PVC = Schedule 40 Polyvinylchloride
* = 1 ft Sump
** = 5 ft Sump
*** = Varying Sump Lengths

Sources DOE, 1987a
EG&G, 1990a
Merrick, 1991
Rockwell International, 1986c
Rockwell International, 1986d
Rockwell International, 1987

2 3 2 Impact of IHSSs on the Quality of Groundwater

Groundwater quality data are compiled as part of the Groundwater Protection and Monitoring Program The primary tasks of this program are to identify hazardous constituents, determine their concentrations, rate of migration, and delineate the horizontal and vertical extent of contaminant plumes Contaminants released at the IHSSs migrate at different rates through various parts of the hydrologic system Figure 1-3 shows the general location of wells used to monitor groundwater quality at the RFP The geologic framework of a specific area directly affects the movement and quality of groundwater. Studies indicate that the subcropping Arapahoe sandstones are hydraulically connected to the Rocky Flats Alluvium (Rockwell International, 1989a) The hydraulic conductivity for alluvial and bedrock units varies but has generally been determined to be equal to or less than 10^{5} cm/sec for the Rocky Flats Alluvium and the subcropping sandstones and 10^{-7} to 10^{-8} cm/sec for claystones The claystones act as aquitards and restrict the movement of groundwater from the alluvium and subcropping sandstones to deeper permeable units The wells that are installed in claystones are generally dry or only yield enough water for analysis of a partial suite of analytes

A total of 371 wells have been installed to monitor groundwater at the RFP Table 2-4 gives the locations of these wells Of the 371 wells at the RFP, only 259 are routinely monitored The remaining 112 wells are damaged and cannot be accurately sampled or they are completed at the same location in the same hydrologic unit and are redundant. Table 2-5 lists the constituents for which analyses are regularly performed on groundwater samples As more detailed statistical interpretations are completed, historical values will be compared to future values to identify contamination and separate local variations in the background water chemistry as reported in the Annual Background Geochemical Reports Data included in the Annual Background Geochemical Reports are from areas unaffected by the Plant's operations and included groundwater, surface water, soils and sediments values Figure 2-13 shows the approximate outline of the

Table 2-4

Area and Year Groundwater Monitoring Wells Were Installed

Areal Location[1)]	Wells Installed Before 1989	Wells Installed In 1989 & 1990	Total Number of Wells Installed
Solar Evaporation Ponds	33	32	65
Present Landfill	25	13	38
West Spray Field	18	8	26
Original Process Waste Line	2	3	5
903 Pad	15	--	15
Mound	14	--	14
East Trenches	27	8	35
881 Hillside	37	3	40
Piezometers	--	44	44
Background	8	63	71
East Buffer Zone	14	4	18
TOTAL	193	178	371

1) See Plate 1

Table 2-5

CHEMICAL CONSTITUENTS ANALYZED IN GROUNDWATER AT THE RFP

FIELD PARAMETERS

pH
Temperature
Specific conductance
Dissolved oxygen
Alkalinity
Turbidity
Water Level

TARGET COMPOUNDS LIST (TCL)

ORGANICS

Chloromethane
Bromomethane
Vinyl Chloride
Chloroethane
Methylene Chloride

Acetone
Carbon Disulfide
1,1-Dichloroethene
1,1-Dichloroethane
1,2-Dichloroethene(Total)

Chloroform
1,2-Dichloroethane
2-Butanone
1,1,1-Trichloroethane
Carbon Tetrachloride

Vinyl Acetate
Bromodichloromethane
1,2-Dichloropropane
cis-1,3-Dichloropropene
Trichloroethene

Dibromochloromethane
1,1,2-Trichloroethane
Benzene
trans-1,3-Dichloropropene
Bromoform
4-Methyl-2-pentanone
2-Hexanone

Table 2-5 (continued)

CHEMICAL CONSTITUENTS ANALYZED IN GROUNDWATER AT THE RFP

ORGANICS (cont)

Tetrachloroethene
Toluene
1,1,2,2-Tetrachloroethane

Chlorobenzene
Ethyl Benzene
Styrene
Xylenes (Total)

INORGANICS

Total Dissolved Solids (TDS)
Nitrate/Nitrite
Orthophosphate
Ammonia
Cyanide

MAJOR ANIONS

Chloride
Fluoride
Sulfate
Carbonate
Bicarbonate

MAJOR CATIONS

Calcium
Magnesium
Potassium
Sodium

TARGET ANALYTE LIST (TAL)

TRACE METALS

Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium

Table 2-5 (continued)

CHEMICAL CONSTITUENTS ANALYZED IN GROUNDWATER AT THE RFP

METALS (cont)

- Cesium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Lithium
- Manganese
- Nickel
- Selenium
- Silver
- Strontium
- Thallium
- Tin
- Vanadium
- Zinc

RADIOCHEMICAL PARAMETERS

- Gross Alpha
- Gross Beta
- Tritium
- Uranium $^{(233\ 234\ 235\ 238)}$
- Plutonium $^{(239\ 240)}$
- Americium ^{241}
- Strontium $^{(89\ 90)}$
- Cesium ^{137}
- Radium $^{(226\ 228)}$

contaminated groundwater plumes on the RFP Due to the local variations in groundwater, the impacts of contaminants identified in OU1, OU2, OU4, OU7, and OU11 are discussed separately

881 Hillside (OU1)

The 881 Hillside is located at the south central portion of the RFP (Figures 2-13 and 2-14) The area was selected as a High Priority Site because of the elevated concentrations of volatile organic compounds (VOCs) detected in the alluvial groundwater, the relatively permeable soils, and the proximity of the area to Woman Creek The Final Phase III RCRA Facility Investigation/Remedial Investigation (RFI/RI) Work Plan Revision 1, Rocky Flats Plant 881 Hillside Area Operable Unit No. 1 (EG&G, 1991d), as directed by the IAG, outlines the activities required to identify the extent of contamination.

Data collected from monitoring wells at 881 Hillside in 1989 generally support conclusions regarding the magnitude and extent of contamination presented in the 1988 Annual Monitoring Report (Rockwell, 1989a) which revealed that VOC contamination exists in the uppermost groundwater system at 881 Hillside In samples collected during 1989, concentrations of the most common organic contaminants at 881 Hillside, trichloroethene (TCE), tetrachloroethene (PCE), and 1,1,1 trichloroethane (1,1,1 TCA), were detected in concentrations above 5,000 µg/L Concentrations of this magnitude are, however, very limited in lateral and vertical extent (DOE, 1990a)

Maximum VOC values occur in IHSSs 119 1 and 119 2 (Figure 2-15) which were used as barrel storage areas, indicating that VOCs have not travelled far in the groundwater from the original storage site Concentrations of the VOCs diminish rapidly downgradient of the two IHSSs to levels at or below detection limits (5 µg/L)

Above-background total dissolved solids (TDSs) and major ion concentrations also occur in alluvial groundwater at 881 Hillside Some of these constituents have migrated farther downgradient than the VOCs and the impact to the environment is being investigated as identified in the IAG Certain metals, including strontium, selenium, and uranium also are present above background concentrations and generally occur where major ion concentrations also are elevated Uranium is the only radionuclide above background levels in the alluvial groundwater downgradient of IHSSs 119 1 and 119 2 (Figure 2-15)

Unweathered bedrock groundwater at 881 Hillside does not appear to be impacted by contaminated groundwater which is transported in the alluvial groundwater system Information on groundwater quality for 881 Hillside is reported in the Phase III OU1 RFI/RI Workplan This is a current study and more information will be gathered through monitoring and remediation activities

903 Pad, Mound, and East Trenches (OU2)

The 903 Pad is located in the southeast corner of the RFP just inside the inner east gate (Figures 2-13 and 2-16) The Mound is located north of Central Avenue at the southeast corner of the PA The East Trenches straddle the East Access Road east of the inner gate The 903 Pad and the Mound were historically used for the storage and burial, respectively, of radioactively contaminated wastes Radioactively contaminated sludge and other materials were buried in the trenches VOC contamination occurs in the alluvial groundwater system at of this area and consists primarily of elevated values of TCE, PCE, and carbon tetrachloride (CCl_4) Elevated values of TCE represent the highest levels of contamination, which extends approximately 600 ft southeast of the 903 Pad to Well 14-87 and approximately 1,500 ft to the northeast of the pad to Well 39-86 Trichloroethene concentrations ranged up to 12,000 µg/L in contaminated monitoring well water samples during 1989, but contamination of this magnitude is limited in the areal extent The geometric mean concentration for TCE during the second quarter 1989 sampling round for 10 wells with contaminated groundwater was 107 µg/L (Figure 2-17)

Elevated PCE concentrations are more limited in areal extent than TCE The extent of PCE contamination falls within the plume boundaries shown in Figure 2-13 Carbon tetrachloride contamination in the groundwater ranges up to 1,100 µg/L with a geometric mean of 400 µg/L for the 9 wells with CCl_4 detection in the second quarter 1989

Volatile organic contamination occurs in the unconfined groundwater system at the 903 Pad where the subcropping Arapahoe Sandstone No 1 is in hydraulic connection with overlying alluvium However, confined bedrock groundwater systems beneath Sandstone No 1 show no indication of having been impacted

Certain inorganic constituents and radionuclides have elevated concentrations higher than background values at the 903 Pad, but do not comprise a well-defined plume of contamination Information on groundwater quality is reported in the Phase II RI/FS Work Plan, Rocky Flats Plant, 903 Pad, Mound, and East Trenches Areas, Operable Unit No 2 (Rockwell International, 1989b)

Solar Evaporation Ponds (OU4)

The Solar Evaporation Ponds are monitored under a Groundwater Quality Assessment Program and are located in the northeast section of the Protected Area (PA) (Figures 2-13 and 2-18) These ponds historically were used to temporarily store and treat by evaporation various process aqueous wastes including those with low-level radioactivity, high nitrates and acids, and sewage effluent The configuration of these ponds has changed several times, since they were installed in 1953 Historically, the integrity of the pond liners was found to pose a potential risk to the substratum (DOE, 1988b). Previous hydrological investigations of the Solar Evaporation Pond area indicate that the groundwater has been impacted by leakage from the ponds Appendix A of the 1989 Annual RCRA Groundwater Monitoring Report for Regulated Units at Rocky Flats Plant (EG&G, 1990c) contains all the available 1988 and 1989 analytical data. Data are generally available for the second quarter 1988 through the second quarter 1989. Appendix B of the same report shows concentrations for every detection above the upper limit of the background tolerance levels

Monitoring wells in the alluvial materials show elevated concentrations of nitrate/nitrite, uranium, tritium, dissolved solids (TDSs), sulfate, chloride, strontium, sodium, and magnesium Isopleths of nitrate/nitrite concentrations are shown on Figure 2-19 Some of the observed contaminants, (nitrate, TDS, sulfate, chloride, sodium and magnesium) are very mobile in the groundwater system The mobility of other constituents, such as uranium, are quite dependent upon pH and Eh conditions. Table 2-6 outlines the number of detections above background and the maximum value observed (Rockwell International, 1989c) The highest concentrations for TDS and nitrate/nitrite (1,900 and 4,800 mg/L, respectively) occurred at the north side of the Solar Evaporation Ponds from wells completed in weathered claystone The highest concentrations of uranium and tritium (250 and 9,000 pCi/L, respectively) occurred on the east side of the Solar Evaporation Ponds in wells completed in alluvial materials

Wells upgradient from the Solar Evaporation Ponds contain groundwater contaminated with VOCs VOCs are not characteristic of solar pond water It is suspected that the source of the VOC contamination in OU4 was from the original pond or from the original process waste lines in that area Both of these sources lie to the west of the current Solar Evaporation Ponds Groundwater in the confined flow system of deeper sandstones, which do not subcrop within the operable unit, does not appear to be impacted by the ponds because nitrate/nitrite, total dissolved uranium, and tritium concentrations are below background levels

Groundwater contamination from the Solar Evaporation Ponds is migrating in a northeasterly direction within surficial materials and weathered bedrock and has reached the North Walnut Creek drainage Figure 2-19 shows nitrate/nitrite concentrations in the

Table 2-6

Solar Evaporation Pond
Summary of 1988-1989 Data
Above Site-wide Background Upper Tolerance Level*

Analyte	Geologic Unit	Background Values mg/L	Maximum Value mg/L
Metals			
Aluminum	Qvf	0 2	0 324
	Kcl	0 2	0 466
Antimony	Qrf	0 06	0.118
	Qvf	0 06	0 198
	Kcl	0 06	0 628
	Kss(u)	0 06	0 130
Arsenic	Kcl	0 01	0 154
	Kss(u)	0 019	0 021
Barium	Qvf	0 2	0 4
	Kcl	0 2	0 3
	Kss(u)	0 2	0 3
Cadmium	Kcl	0 005	0 011
Chromium	Qrf	0 01	0 020
	Qvf	0 01	0 040
	Kcl	0 01	0 030
	Kss(u)	0 01	0.045
Cobalt	Qrf	0 05	0 050
Copper	Qrf	0 025	0 158
	Qc	0 025	0 032
	Kcl	0 025	0 038
	Kss(u)	0 025	0 112
Iron	Qrf	0 27	0 039
	Qc	0 1	0 1
	Qvf	0 1	1 0
	Kcl	0 1	2 4
	Kss(u)	0 1	2 2
Lead	Qrf	0 005	0 040
	Qvf	0.005	0 047
	Kcl	0.005	0 23
	Kss(u)	0.025	0 099

Table 2-6 (continued)

Solar Evaporation Pond
Summary of 1988-1989 Data
Above Site-wide Background Upper Tolerance Level*

Analyte	Geologic Unit	Background Values mg/L	Maximum Value mg/L
Lithium	Qrf	0 01	1 4
	Qc	0 17	0 28
	Qvf	0 17	0 27
	Kcl	0 038	1 2
	Kss(u)	0 1	0 4
Manganese	Qrf	0 365	1 242
	Qc	0 088	2 66
	Qvf	0 088	4 37
	Kcl	0.126	0 451
	Kss(u)	9 41	0 376
Mercury	Qrf	0 0002	0 0003
Molybdenum	Qrf	0 036	0 084
Nickel	Qrf	0 0432	0 394
	Qvf	0 04	0 121
	Kcl	0 04	0 174
	Kss(u)	0 04	0 076
Selenium	Qrf	0 005	0 037
	Qc	0 005	0 498
	Qvf	0 005	0 322
	Kcl	0 005	0 455
Silver	Kss(u)	0 01	0 033
Strontium	Qrf	0 16	4 44
	Qc	1	5
	Qvf	1	7
	Kcl	1	20
	Kss(u)	0 45	6 17
Tin	Qrf	0 1	0.126
	Qc	0 1	0 182
	Kcl	0 1	0 222
	Kss(u)	0 1	0 106
Zinc	Qrf	0 14	0 64
	Qc	0 02	0 04
	Qvf	0 02	0 13
	Kcl	0 11	5 0

Table 2-6 (continued)

Solar Evaporation Pond
Summary of 1988-1989 Data
Above Site-wide Background Upper Tolerance Level*

Analyte	Geologic Unit	Background Values mg/L	Maximum Value mg/L
Inorganics			
Calcium	Qrf	85	480
	Qc	74	516
	Qvf	77	827
	Kcl	73	1,700
	Kss(u)	65	421
Chloride	Qrf	16 0	366
	Qc	20	170
	Qvf	40	152
	Kcl	11	933
	Kss(w)	15	93
Magnesium	Qrf	5 8	71 6
	Qc	15	165
	Qvf	15	254
	Kcl	45	553
	Kss(w)	9 4	16 8
	Kss(u)	5.0	130
Nitrate/Nitrite	Qrf	3 0	6600
	Qc	018	480
	Qvf	0 69	763
	Kcl	0 58	48000
	Kss(w)	1 6	387
	Kss(u)	0 61	1 4
Potassium	Qrf	7 73	435
	Qvf	5	6
	Kcl	5	188
	Kss(u)	21 89	7050
Sodium	Qrf	13	1800
	Qc	99	337
	Qvf	99	369
	Kcl	37	1390
	Kss(w)	26	72
	Kss(u)	600	761

Table 2-6 (continued)

Solar Evaporation Pond
Summary of 1988-1989 Data
Above Site-wide Background Upper Tolerance Level*

Analyte	Geologic Unit	Background Values mg/L	Maximum Value mg/L
Sulfate	Qrf	45	340
	Qc	86	640
	Qvf	150	930
	Kcl	44	8300
	Kss(w)	48	120
	Kss(u)	950	1360
Total Dissolved Solids	Qrf	352	12000
	Qc	520	4600
	Qvf	947	5210
	Kcl	320	19000
	Kss(w)	220	3400
	Kss(u)	1760	2337
HCO3-	Qrf	436	5610
	Qc	470	1000
	Qvf	719	768
	Kcl	400	500
	Kss(w)	230	380
	Kss(u)	412	540
Cyanide	Kss(w)	0 0025	0 0036

Table 2-6 (continued)

Solar Evaporation Pond
Summary of 1988-1989 Data
Above Site-wide Background Upper Tolerance Level*

Analyte	Geologic Unit	Background Values (pCi/L)	Maximum Value (pCi/L)
Dissolved Radiochemistry			
Gross Alpha	Qrf Qvf Kcl Kss(w)	12 543 13 515 12 7	773±47 110±70 390±60 41 2±8 9
Gross Beta	Qrf Qvf Kcl Kss(w)	14 57 18 53 7 2	940±80 32.9±4 8 284±12 154±7
Uranium 233 234	Qrf Qvf Kcl Kss(w)	1 647 6 481 5 8 1 1	250±10 30±3 210±20 32 4±3 4
Uranium 235	Qvf Kcl Kss(u)	0 232 0 2 0 135	1 1±0 3 7 8±1 1 0 37±0 05
Uranium 238	Qrf Qvf Kcl Kss(w)	0 19 5 08 3 2 0 6	220±20 23±1 140±10 28 4±3 2
Strontium 89 90	Qrf Kcl Kss(w)	0 55 0 1 -0 1	202 5.6 0 58±0.33
Plutonium 239 240	Qrf Qvf Kcl Kss(w)	0 009 0 012 0 3 0 01	0 19±0 06 0 05±0 02 0 58±0 29 0 34±0 03
Americium 241	Qvf Kss(w) Kss(u)	0 012 0 01 0 019	0 11±0 08 0 57±0 10 0.11±0.05
Cesium	Kss(w)	0 3	0 46±0 67

Table 2-6 (continued)

Solar Evaporation Pond
Summary of 1988-1989 Data
Above Site-wide Background Upper Tolerance Level*

Analyte	Geologic Unit	Background Values (pCi/L)	Maximum Value (pCi/L)
Tritium	Qrf Qc Qvf Kcl Kss(w)	309 100 505 100 100	9000±300 250±170 1400±100 8100±300 1700±230

Qvf = Valley Fill Alluvium
Qrf = Rocky Flats Alluvium
Qc = Colluvium
Kss(u) = Unweathered Sandstone
Kss(w) = Weathered Sandstone
Kcl = Bedrock Weathered Claystone

* When no tolerance level, highest background value is shown

Source EG&G, 1990c

uppermost aquifer extending to the northeast approximately 1,100 feet from the northeast corner of the Solar Evaporation Pond area

The extent of this plume also is representative of the extent of elevated values for TDS, inorganics, and some metals The analytical data indicate that the maximum concentrations of all the contaminants occur in the immediate area of the Solar Evaporation Pond and fall off rapidly downgradient

In response to nitrate/nitrite contamination detected in North Walnut Creek, a series of trenches and sumps were installed north of the Solar Evaporation Ponds during the period from 1971 to 1974 The trenches and sumps were replaced by a more extensive French drain system in the early 1980s The purpose of this system is to intercept and collect surface water and shallow groundwater in the immediate area and transfer it to the Solar Evaporation Ponds (ASI, 1991a) The 1989 alluvial groundwater data indicate that contamination occurs downgradient from the French drain system, thereby supporting the recommendation for a more detailed evaluation of the French drain system as outlined in the Hydrological Characterization Report (DOE, 1988b)

Results from 1989 do not seem to indicate groundwater contamination migration in non-northerly directions, moreover, some monitoring wells may be influenced by other contaminant sources (Rockwell International, 1989c) Specifically, VOCs were detected upgradient from the ponds and in the South Walnut Creek alluvium These compounds are not found as a source within the Solar Evaporation Ponds area and are believed to be the result of other waste management practices prior to enforcement of stringent environmental guidelines governing DOE facilities

Present Landfill (OU7)

The Present Landfill is located in the buffer zone to the north of the Controlled Area

(Figures 2-13 and 2-20) In addition to typical sanitary landfill wastes, limited quantities of hazardous wastes were disposed of in the landfill, particularly in the early years of its operation (1968 - 1970) Results from the second quarter 1988 through the quarter 1989 monitoring wells water quality analyses indicate that the alluvial groundwater beneath the Present Landfill has been impacted Appendix E of the 1989 Annual RCRA Groundwater Monitoring Report for Regulated Units at Rocky Flats Plant (EG&G, 1990c), lists all of the results of the sampling completed for the second quarter 1988 through the fourth quarter 1989 Appendix F of the same report shows each detection above current background in the Present Landfill area Elevated TDS, major ions, barium, calcium, iron, magnesium, zinc, sulfate, manganese, chlorine, strontium, tritium, and uranium have been detected in monitoring wells in the area Table 2-7 summarizes the maximum value detected for each analyte VOCs have been detected within the Present Landfill (EG&G, 1991a)

Major ions, iron, manganese, zinc, and other metals found in the monitoring wells at the landfill are those generally typical of sanitary landfills Elevated concentrations of at least strontium and chloride are considered unrelated to the landfill and are due to mineralogical differences between water-bearing units Figure 2-21 shows the TDS concentrations in the unconfined groundwater flow system

Comparisons were made of the concentrations of the analyzed constituents between upgradient landfill monitoring well samples, the RFP background groundwater quality, and well samples taken within and downgradient from the landfill The results show that the groundwater contamination varies with each location The comparisons are fully described in the 1989 Annual RCRA Groundwater Monitoring Report (EG&G, 1990c),

Table 2-7

Present Landfill
Summary of 1988-1989 Data
Above Sitewide Background Upper Tolerance Level*

Analyte	Geologic Unit	Background Values mg/L	Maximum Value mg/L
Metals			
Aluminum	Qrf	0 2	0 4
Barium	Qrf Kss(u)	0 2 0 2	0 8 0 4
Beryllium	Qrf	0 005	0 007
Calcium	Qrf Qvf Kcl Kss(u)	85 138 73 65	130 270 137 114
Chromium	Qrf Qvf Kss(u)	0 01 0 01 0 01	0 07 0 01 0 02
Copper	Qrf Qvf Kss(u)	0 025 0 025 0 025	0 63 0 52 0 026
Iron	Qrf Kss(u)	0 266 0 1	14 6 0 32
Lead	Qrf Qvf	0 005 0 028	0 0053 0 05
Lithium	Kcl Kss(u)	0 0381 0 1	0 2 0 13
Magnesium	Qrf Qvf Kss(u)	5 79 26 57 5	29 6 319 28
Manganese	Qrf Kcl Kss(u)	0 365 0 126 0 0182	5 08 0 373 0 194
Mercury	Qrf	0 0002	0 001
Molybdenum	Qrf Kcl	0 0136 0 015	0 355 0 111
Nickel	Qrf Qvf	0 0432 0 04	0 287 0 04
Potassium	Qvf	5	9 40

Table 2-7 (continued)

Present Landfill
Summary of 1988-1989 Data
Above Sitewide Background Upper Tolerance Level*

Analyte	Geologic Unit	Background Values mg/L	Maximum Value mg/L
Selenium	Qrf Kcl	0 005 0 005	0 14 0 432
Silver	Qrf	0 01	0 02
Sodium	Qrf Qvf Kcl	13 4 88 36 9	94 7 1100 214 00
Strontium	Qrf Qvf Kcl Kss(u)	0 159 1 1 0 451	0 900 7 89 1 20 1 7
Vanadium	Qrf	0 05	0 100
Zinc	Qrf Qvf Kcl	0 141 0 0212 0 107	1 70 0 035 0 123
Inorganics			
Nitrate/Nitrite	Qrf Kcl	2 98 0 58	6 4 32
Chloride	Qrf Qvf Kcl Kss(w) Kss(u)	15 6 40 11 15 607	56 3 271 71 460 958
Sulfate	Qrf Qvf Kcl Kss(w)	 45 1 150 44 48	220 4120 590 520
Total Dissolved Solids	Qrf Qvf Kcl Kss(w) Kss(u)	352 947 320 220 1760	618 7430 1200 1900 2012
Bicarbonate	Qrf Kss(w)	436 230	499 260
Carbonate	Kss(u)	49	130

Table 2-7 (continued)

Present Landfill
Summary of 1988-1989 Data
Above Sitewide Background Upper Tolerance Level*

Analyte	Geologic Unit	Background Values (pCi/L)	Maximum Value (pCi/L)
Dissolved Radiochemistry			
Gross Alpha	Qrf Qvf Kss(w)	12 5 13 5 7	44±9 110±35 38 1±3 3
Gross Beta	Qrf Qvf Kss(w)	14 6 18 5 2	25 8±3 4 54±50 31 8±3 3
U 233 234	Qrf Qvf Kss(w)	1 65 6 48 1 1	10±1 102±8 30 8±3 0
U 235	Qvf	0 23	3.4±0 4
U 238	Qrf Qvf Kss (w)	0 19 5 08 0 6	8 4±0 9 64±6 17 5±2 2
Pu 239 240	Qrf	0 009	0 04±0 02
Am 241	Kss(w) Kss(u)	0 01 0 019	0 167±0 48 0 84± 0 44
Tritium	Qrf	309	2300±200
Sr 89 90	Kss(w)	-0 1	0 064±0 33

Qvf = Valley Fill Alluvium
Qrf = Rocky Flats Alluvium
Qc = Colluvium
Kss(u) = Unweathered Sandstone
Kss(w) = Weathered Sandstone
Kcl = Bedrock Weathered Claystone

* When no tolerance level, highest background value is shown

Source EG&G, 1990c

which states that for some constituents above-background analyte concentrations are within the Present Landfill boundaries

Bedrock water quality does not appear to have been impacted, based upon current groundwater quality analyses although some well samples showed slightly elevated values for some metals, major ions, and TDS These values are attributed to background water quality in the Present Landfill area (EG&G, 1990c)

West Spray Field (OU11)

The West Spray Field is located in the buffer zone near the West Access Road (Figures 2-13 and 2-22) Water from the Solar Evaporation Ponds was spray irrigated at this site during the period from 1982 through 1985 The water which was spray irrigated came from the interceptor trench north of the Solar Evaporation Ponds and STP effluent. The schedule of application volumes of these sources are summarized on Tables 2-8 and 2-9 This water contained elevated concentrations of nitrate/nitrite, gross alpha activity, gross beta activity, and trace levels of VOCs The potential source of contaminants to the groundwater system is from infiltration of the applied effluent

Alluvial Wells (OU11)

The second quarter 1988 through the second quarter 1989 data (and some fourth quarter 1989 data for 1989 wells) for metals, inorganic material, and dissolved radiochemistry show above-background concentrations Appendix C of the 1989 Annual RCRA Groundwater Monitoring Report for Regulated Units at Rocky Flats Plant (EG&G, 1990c) provides all of the available 1988 and 1989 analytical data Appendix D of the same report shows concentrations for every detection above the upper limit of the background tolerance intervals The results indicate that Well 49-86 within the West Spray Field consistently showed nitrate/nitrite concentrations above 10 mg/L Wells 10-81 and 51-86

Table 2-8

Application of Liquid from Pond 207-B North* to the West Spray Field

Month/Year	Volume Applied (gallons)
4/82	522,000
6/82	760,000
10/82	244,000
Yearly Subtotal	**1,526,000**
1/83	555,000
6/83	865,000
7/83	1,112,000
11/83	367,000
Yearly Subtotal	**2,899,000**
3/84	231,000
4/84	864,000
5/84	216,000
7/84	169,000
10/84	929,000
Yearly Subtotal	**2,409,000**
3/85	132,000
7/85	1,266,000
10/85	781,000
Yearly Subtotal	**2,179,000**
TOTAL	**9,013,000**

* Source of this liquid was groundwater and seepage collected by the Intercepter Trench Pump House (ITPH) System

Source Rockwell International, 1986c

Table 2-9

Application of Liquid from Pond 207-B Center* to the West Spray Field

Month/Year	Volume Applied (gallons)
4/82	2,971,000
5/82	4,869,000
6/82	3,307,000
7/82	3,179,000
8/82	2,130,000
9/82	2,334,000
10/82	3,371,000
11/82	3,018,000
12/82	434,000
Yearly Subtotal	**25,613,000**
1/83	556,000
2/83	1,193,000
3/83	760,000
5/83	822,000
6/83	1,135,000
7/83	2,140,000
8/83	1,426,000
9/83	1,277,000
10/83	1,859,000
11/83	1,691,000
12/83	2,493,000
Yearly Subtotal	**15,350,000**
2/84	2,209,000
3/84	710,000
4/84	597,000
5/84	2,315,000
6/84	1,901,000
7/84	1,488,000
10/84	660,000
12/84	1,825,000
Yearly Subtotal	**2,409,000**
1/85	2,087,000
2/85	250,000
3/85	455,000
4/85	1,265,000
5/85	110,000
6/85	528,000
Yearly Subtotal	**4,695,000**
TOTAL	**57,363,000**

* Source of this liquid was treated sanitary effluent from the Rocky Flats Plant Sanitary Wastewater Treatment Plant (Building 995) Some limited transfers of contaminated groundwater/seepage from Solar Pond 207B-North to 207B-Center may have occurred

Source Rockwell International, 1986c

placed to monitor water quality upgradient of the West Spray Field also exceeded background nitrate as N concentrations during second quarter 1989 with values ranging between 3 and 7 mg/L Figure 2-23 outlines the presence of nitrate/nitrite concentrations at the West Spray Field Because nitrate is so mobile, the plume is believed to show the maximum extent of contamination

Several sample analyses of aluminum, iron, and zinc concentrations occur above background, but not consistently Results do indicate, however, that analyses from Wells 5-82 and 49-86 regularly showed sodium, sulfate, and chloride concentrations above background levels Table 2-10 is a summary of the second quarter 1988 through fourth quarter 1989 data showing detections above the background upper tolerance level. No VOCs were found above the detection limit in samples collected in the second quarter 1989 Inspection of the other 1988 and 1989 data confirms that VOCs are not contaminants at the West Spray Field

Bedrock Wells (OU11)

Wells placed to monitor bedrock groundwater quality show that VOCs, radionuclides, and inorganics were below background during second quarter 1989 To date, bedrock water quality does not appear to have been impacted by activities at the West Spray Field.

In summary, hydrologic investigations at the West Spray Field show the application of liquids from the Solar Evaporation Ponds resulted in localized elevated levels of nitrate/nitrite in alluvial groundwater only A limited number of other constituents occur at, or slightly above, background Only nitrate/nitrite occurs at concentrations above the proposed concentration limit for drinking water of 10 mg/L and is limited to groundwater within the alluvium

Table 2-10

West Spray Field
Summary of 1988-1989 Data
Above Sitewide Background Upper Tolerance Level*

Analyte	Geologic Unit	Background Values (mg/L)	Maximum Value (mg/L)
Metals			
Aluminum	Qrf	0 2	3 99
Barium	Qrf Kss(u)	0 2 0 2	0 25 0 22
Cadmium	Qrf Kss(u)	0 005 0 005	0.018 0 008
Chromium	Qrf Kss(u)	0 01 0 01	0 03 0.02
Copper	Qrf Qvf	0 025 0 025	0 036 0 28
Iron	Qrf Kss(u)	0 27 0 18	2 67 0 101
Magnesium	Qrf Kss(u)	5 80 5 0	40 3 12
Manganese	Qrf Kss(u)	0 3 0 018	0.537 8 112
Silver	Qrf	0 01	0 05
Sodium	Qrf	13	104
Strontium	Qrf Kss(u)	0 01 0 45	1 10 0 516
Zinc	Qrf Qvf	0 14 0 021	1 840 0 074
Inorganics			
Nitrate/Nitrite	Qrf Qvf Kss(u)	3 0 0 69 0 61	13 3 2.7 5 1
Chloride	Qrf Qvf	16 40	77 3 51 40
Sulfate	Qrf	5 1	90
Total Dissolved Solids	Qrf	352	1040

Table 2-10 (continued)

West Spray Field
Summary of 1988-1989 Data
Above Sitewide Background Upper Tolerance Level

Analyte	Geologic Unit	Background Values (pCi/L)	Maximum Value (pCi/L)
Dissolved Radiochemistry			
Gross Alpha	Qrf	12 543	26+/-8
Gross Beta	Qrf	14 57	24+/-12
Uranium 233, 234	Qrf	1 647	3 9+/-0 5
Uranium 235	Kss(u)	0 135	0 16+/-0 09
Uranium 238	Qrf	0 195	3 2+/-2.0
Strontium 89, 90	Qrf	0 552	2.36+/-1.8
Plutonium 239, 240	Qrf	0 009	0 12+/-0 07
Americium 241	Kss(u)	0 019	0 11+/-0 10
Tritium	Qrf(u)	309 149	380+/-100

Notes

Qrf = Rocky Flats Alluvium
Qvf = Valley Fill Alluvium
Kss(u) = Unweathered Sandstone

* When no tolerance level, highest background value is shown

Source EG&G, 1990c

2 3 3 Groundwater Quantity

A preliminary estimate of the quantity of groundwater in storage beneath the RFP was calculated using available data Groundwater in storage at any time is variable and is dependent upon the season of the year and the hydrologic unit of interest. Some alluvial and valley fill units have exhibited variations in water levels over a normal year; whereas, some bedrock units have relatively constant water levels The following estimates of groundwater in storage beneath the RFP are preliminary and subject to change as more data become available The quantities of groundwater in storage generally represent an average annual condition beneath the RFP

Groundwater Storage

The quantity of water in storage beneath the RFP is contained in the alluvial and valley fill materials and bedrock hydrologic units For purposes of the storage estimates in this report, the alluvial and valley fill units are treated as a single hydrostratigraphic unit. Additionally, it is assumed that the storage estimates of the bedrock hydrologic units beneath the RFP are limited to the Arapahoe Formation and the Laramie-Fox Hills hydrologic units These regionally important hydrostratigraphic units were described previously in Section 2 2

Table 2-11 summarizes the estimated water in storage beneath the RFP in alluvial and valley fill, Arapahoe Formation, and the Laramie-Fox Hills hydrologic units. This table also summarizes the assumptions related to areal extent, saturated thickness, and porosity used to estimate the amount of water in storage for each of the three hydrologic units

Saturated thickness of alluvial and valley fill materials was estimated by subtracting the elevation of the top of bedrock from the elevation of the water table in all of the alluvial

Table 2-11

Estimated Groundwater Quantity Beneath Rocky Flats Plant

Hydrostratigraphic Unit	Area (ac)	Average Thickness (ft)	Average Saturated Thickness (ft)	Porosity [1] (%)	Water in Storage (ac-ft)	Water in Storage (gals x 10^9)
Alluvium and Valley Fill	6,470	2)	10[3]	30	19,400	6 3
Arapahoe Formation	4,970	35[4]	35	30	52,200	17 0
Laramie-Fox Hills	6,350	200	120	30	228,600	74 5
TOTAL					300,200	97 8

1) Assumed value based on data presented by Robson (1987)

2) Not estimated

3) Estimated from the difference between alluvial and valley fill groundwater elevation and bedrock elevation throughout the RFP site

4) Thickness of all Arapahoe Formation sandstones and siltstones This does not include 8claystone which is assumed to have no significant recoverable water This reflects a composite of thickness of sandstones which may contain recoverable water

and valley fill wells The total thickness of the alluvial and valley fill materials at the RFP was not estimated An assumed porosity of 30 percent for the alluvium and valley fill and an areal extent of 6,470 acres (ac), give a volume of water in storage in the alluvium and valley fill at the RFP of about 19,400 acre-feet (ac-ft) or about 6,300 million gallons (gal)

The quantity of water beneath the RFP in the Arapahoe Formation was estimated using maps prepared by the Colorado State Engineer (Van Slyke and others, 1988a). The predominant water- yielding strata of the Arapahoe Formation are saturated sandstones and siltstones The claystone/shale units have little water-yielding capability even though large amounts of water may be stored within them The Colorado State Engineer maps do not include the claystone/shale units as part of the thickness of the Arapahoe Formation in the Denver Basin At the RFP, the individual Arapahoe sandstones range in thickness from absent to about 30 ft An average composite saturated thickness of 35 ft was used for the Arapahoe sandstones In addition, a porosity of 30 percent was also assumed for this study The areal extent of 4,970 ac for the Arapahoe Formation hydrologic unit was measured from aquifer limits taken from Van Slyke and others (1988a) The estimated total water in storage in the Arapahoe Formation hydrologic unit beneath the RFP is about 52,200 ac-ft or about 17 billion gal

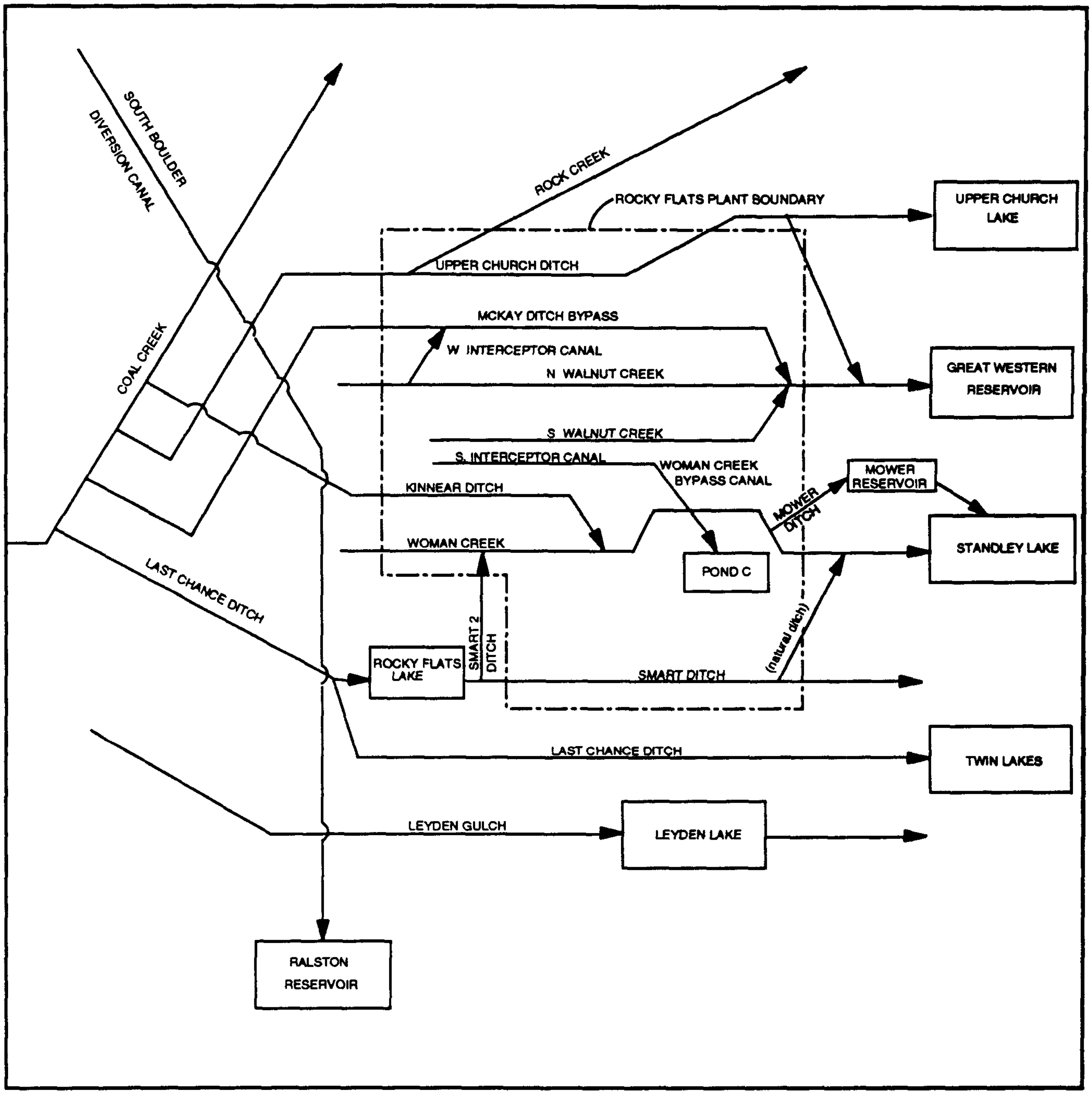
The quantity of water beneath the RFP in the Laramie-Fox Hills aquifer was also estimated using maps prepared by the Colorado State Engineer (Van Slyke and others, 1988b). A saturated thickness of 120 ft was estimated from the maps The areal extent of 6,350 acres was measured from limits taken from Van Slyke and others (1988b). A porosity of 30 percent was assumed The estimated total water in storage in the Laramie-Fox Hills aquifer beneath the RFP is about 228,600 ac-ft or about 74 5 billion gal The total estimated water in storage in the alluvial and valley fill, Arapahoe Formation and Laramie-Fox Hills aquifers beneath the RFP is about 98 billion gal

2 3 4 Interaction with Surface Water

The surface-water system of the RFP is interactive with the underlying groundwater system Surface-water recharge to the alluvium, valley fill, and bedrock occurs as seepage from streams, ditches, and ponds Groundwater is discharged from the Rocky Flats Alluvium and the bedrock seeps wherever groundwater reaches the land surface The surface water and groundwater monitoring programs (Rockwell International, 1989a and 1989c) will eventually quantify losing and gaining reaches of streams and ditches as well as areas of pond seepage for a better understanding of surface-water/groundwater interactions.

Five streams flow through or are adjacent to the RFP site. North Walnut Creek, South Walnut Creek, Woman Creek, Coal Creek, and Rock Creek These streams, except Coal Creek, drain the RFP site area and are characterized as ephemeral (DOE, 1980) (Figure 2-24) North Walnut Creek and South Walnut Creek join to form Walnut Creek, which flows into Great Western Reservoir Woman Creek originates to the west of the RFP, drains the south part of the RFP and flows eastward into Standley Lake The Rock Creek drainage is located in the north part of the RFP Coal Creek flows west and north of the RFP and is joined by Rock Creek northeast of the RFP Coal Creek flows into Boulder Creek, then St Vrain Creek, and eventually the South Platte River

Eight ditches convey water throughout the general RFP area South Boulder Diversion Canal, Last Chance Ditch, Upper Church Ditch, McKay Ditch Bypass, Smart Ditch, Smart 2 Ditch, Mower Ditch, and the Kinnear Ditch (Figure 2-24) The Upper Church Ditch, McKay Ditch Bypass, Kinnear Ditch, and Last Chance Ditch all divert water from Coal Creek to the east, Smart Ditch diverts water from Rocky Flats Lake to the east, and the Smart 2 Ditch diverts water from the Smart Ditch to a Woman Creek tributary The Mower Ditch diverts water from Woman Creek into Mower Reservoir The South Boulder Diversion Canal brings water from South Boulder Creek to Ralston Reservoir The South Boulder Diversion Canal is located west of the RFP and is unlined in the vicinity of the RFP except



SCHEMATIC DIAGRAM OF SURFACE-WATER SYSTEM

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

EG&G

Rocky Flats Plant, Golden, Colorado

FIGURE 2-24

for a cement-lined 100-meter aqueduct that crosses the Woman Creek drainage. Other ditches are unlined and tend to lose water through seepage into the underlying subsurface materials in the area of the RFP

In addition to the ditches described above, other surface-water management controls also are in operation at the RFP The West Interceptor Canal (Figure 2-24) diverts runoff from the headwaters of North Walnut Creek via the McKay Ditch Bypass to Walnut Creek west of Indiana Street The South Interceptor Canal collects runoff from the southern parts of the RFP before it reaches Woman Creek and diverts the collected water into Pond C-2. This runoff includes surface water from OU1, OU5, and part of OU2 In addition to ditches and canals, a series of detention ponds has been constructed to control the release of the RFP discharges and to collect surface runoff (Figure 2-25). Ponds located along North Walnut Creek are designated as ponds A-1 through A-4, and ponds located along South Walnut Creek are designated as ponds B-1 through B-5 Ponds A-1, A-2, B-1, and B-2 are reserved for spill control, Pond B-3 receives treated effluent from the STP, and the remaining A- and B-series ponds receive runoff from the storm-sewer system of the RFP Pond C-1 receives upstream flows from Woman Creek and Pond C-2 collects diverted flow from the South Interceptor Canal A detention pond also is located at the Present Landfill, however, water from this pond is not released as this is not a National Pollutant Discharge Elimination System (NPDES) permitted point-source discharge point Water from this pond is spray irrigated immediately to the north and south of the pond to enhance the evaporation rate of water

Surface-Water Management Programs

The Surface-Water Management Program coordinates all activities and facilitates decision making relative to surface-water issues Included within the program are the NPDES, Federal Facilities Compliance Agreement (FFCA), and NEPA-related data-collection programs These programs ensure compliance with the NPDES, FFCA, and NEPA requirements at designated discharge points, evaluate other onsite sources that may affect NPDES and FFCA discharge point water-quality conditions, and provide water-quality data from other onsite and offsite locations that would be in accordance with historical precedent Specifically, these programs include sampling of the detention ponds prior to and during discharge events to characterize water quality leaving the RFP site Samples also are being collected on an "incidental" basis in response to storm events or accident-related spills that could potentially affect surface-water quality at the RFP The Draft Surface-Water Management Plan (EG&G, 1991e) identifies current surface-water management issues specific to the RFP

Community relations issues are directly addressed by the Surface-Water Management Program Interaction is maintained with Federal and State governments, local governments, specific interest groups, and the general public as listed below. Surface-water management issues are communicated on the RFP through the Rocky Flats employee communications network The Surface-Water Community Relations Plan and the Surface-Water Quality Video address the existing community relations program for surface-water programs. These items are outlined in the 1990 Surface-Water Monitoring Plan (EG&G, 1990e)

Surface-water management addresses responsibilities for emergency response to surface-water-quality issues The Spill Prevention/Contamination Control (SPCC) Plan is discussed in the Surface-Water Management Plan (EG&G, 1991e) The surface-water program also addresses problems with the STP Implementation of new research ideas and conducting continuous influent and effluent monitoring are current efforts in this area Catastrophic and unplanned events are to be handled as outlined in the Surface-Water Management Plan.

Management of surface-water activities includes modifications to surface-water sampling programs, zero discharge option investigations (ASI, 1991b), assessment of current treatment and disposal practices, surface-water system upgrades; compliance programs; and long-term activities planning (EG&G, 1990f) To support surface-water management, additional field data are gathered including hydrologic mass balance information and sediment transport and sediment characterization data used for modeling studies Monitoring of additional meteorological data is planned to facilitate immediate decision making concerning rainfall and accumulated water in the ponds (ASI, 1991c).

Surface-water management includes STP operations Wastewater treatability studies, water recycling projects, and plans for zero discharge are issues discussed in the Surface-Water Management Plan (EG&G, 1991e) A large amount of effort has gone into the evaluation of water storage and disposal options The extent of these options and their evaluations also are covered in the Surface-Water Management Plan

Background Surface-Water Quality and Quantity

The purpose of investigating the onsite background surface-water quality is to establish baseline water-quality characteristics for surface water unaffected by the RFP activities These data can be useful in the identification of areas where surface water and groundwater interact The baseline data are integral to evaluating the magnitude and significance of contaminant releases The background program is described in detail in the Background Geochemical Characterization Report (Rockwell International, 1989d) and results of the initial two rounds of sampling are presented in a draft report (DOE, 1990a). The water samples were analyzed for the Contract Laboratory Program (CLP) Target Analyte List (TAL) metals as well as cyanide, major anions, and isotope specific radionuclides The background surface waters can be described as containing predominantly calcium bicarbonate with relatively low TDS (mean TDS 178 of mg/L). Preliminary data suggest that the RFP surface waters may become less concentrated in sodium chloride and more concentrated in calcium bicarbonate as they flow from west to east (Rockwell International, 1989c)

Based upon results of a regional analyses of mean annual watershed yields, the historical, undeveloped, annual water yield of Walnut Creek is estimated at 34.5 acre-feet per year (ac-ft/yr), and the historical, undeveloped, annual water yield of Woman Creek is estimated at 32 1 ac-ft/yr (ASI, 1990)

RFP-Influenced Surface-Water Quality

Surface-water quality is monitored at the terminal ponds prior to any releases from the RFP site, however, surface-water quality has been impacted by the RFP operations at several areas upstream of these ponds Some of these areas are monitored for aspects of quality and quantity on an event basis using appropriate sampling equipment (ASI, 1991d).

Solar Evaporation Ponds (OU4)

The Solar Evaporation Ponds located within the PA at the northeast corner of the RFP have historically contained elevated concentrations of nitrate/nitrite, dissolved radionuclides, and several trace metals and major ions (DOE, 1990a) Seeps located north of the ponds contain high nitrate/nitrite and uranium concentrations Most seepage currently is collected by a surface-water intercept ditch system that is part of the interceptor trench system which collects runoff and groundwater north and east of the ponds. The collected water is currently pumped back to the Solar Evaporation Pond 207B North (EG&G, 1991a). The Solar Evaporation Ponds are scheduled for closure as indicated in the IAG. They will be emptied of all remaining liquids and sludges as soon as possible It is anticipated that water in the ponds and from the interceptor trench system will then be treated by vapor compression evaporators (EG&G, 1990g) The impact the Solar Evaporation Pond activities has had on groundwater quality is being studied through IM/IRA and RFI/RI processes as scheduled in the IAG

Pad 903, Mounds, and East Trenches (OU2)

Seeps occur southeast of the 903 Pad in the lip area and contain above-detection concentrations of VOCs including the following 1,1- dichloroethene (DCE); 1,2-DCE, carbon tetrachloride (CCl_4), trichloroethene (TCE), and perchloroethene (PCE) (DOE, 1990b) Above-background concentrations of dissolved solids, major ions, selected trace metals, and uranium, also have been noted in some of these seeps (EG&G, 1990e) Groundwater monitoring wells in the area also contain detectable concentrations of some VOCs The 903 Pad area was used as a storage site for radioactively-contaminated used machine cutting oil and is probably the source of groundwater and surface-water contamination in the area (EG&G, 1990e)

Northeast of the Mound Area, South Walnut Creek receives flow from a concrete culvert, metal culvert, and seepage or buried pipe that contribute detectible VOC concentrations Surface-water samples from these sites have high elevated concentrations of CCl_4, PCE, TCE, 1,1-DCE, 1,1-dichloroethane (DCA), and 1,2- (DCE), vinyl chloride, acetone, bromo-dichloromethane, and methylene chloride, although the latter three compounds may be derived from laboratory contamination (DOE, 1990b)

One seep located northeast of the East Trenches area also contains low levels of CCl_4 (<10 µg/L), which reflects contaminated groundwater reaching the surface (DOE, 1990b) A project is being initiated to collect and treat water at the sites The details for collecting and treating sources in OU2 are described in the OU2 Interim Remedial Action Plan (Draft).

Woman Creek and Walnut Creek (OU5 and OU6)

The A-, B-, and C-series detention ponds and the Present Landfill pond potentially may be impacting the groundwater system through infiltration and are being investigated accordingly Preliminary water-balance calculations for Pond C-2 suggest it may leak, however, present data are incomplete The ongoing surface-water and groundwater monitoring programs, together with results of the Zero-Offsite Water-Discharge Study (ASI, 1991b) and the event-related sampling at automated stations, will provide useful data on the significance of pond recharge to the underlying groundwater system and the extent to which groundwater quality is being impacted

The terminal detention ponds (Pond A-4 on North Walnut Creek, Pond B-5 on Walnut Creek, and Pond C-2 on Woman Creek, Figure 2-25) are NPDES-regulated discharge points and are monitored for specified water-quality characteristics before discharge. Currently, all water discharged from these terminal detention ponds is treated by a combined system of filters and granulated activated carbon (GAC) located at Pond A-4 before being released into Woman or Walnut Creek (ASI, 1991e). Excess water in terminal ponds B-5 and C-2 is normally piped to Pond A-4 If Pond A-4 reaches capacity and discharge is needed, it is conducted in a controlled manner only after detailed assessment of water quality and consultation/notification of downstream cities, CDH, and DOE. Review of sampling and analysis results determines whether treatment of the water is required The City of Broomfield has constructed a diversion ditch (The Broomfield Diversion Ditch) around Great Western Reservoir downstream from Ponds A-4 and B-5 This ditch intercepts Pond A-4 and B-5 discharges and routes them to Walnut Creek below the Reservoir

As stated above, Pond C-2 discharge is normally routed to Pond A-4 Recently, this water has been directly discharged to the Broomfield Diversion Ditch, but only after sampling, analysis and consent of the appropriate parties This practice may continue in the future dependent on water quality results, regulatory requirements, and consent of the aforementioned parties The surface-water and groundwater monitoring programs are investigating the contribution of groundwater to detention ponds and stream reaches and the potential infiltration of diverted and detained water into the groundwater system.

The purpose of the site-wide monthly surface-water sampling program is to obtain information for evaluating the significance and impacts of potential contaminant releases to surface waters In addition to collecting samples for geochemical analyses, monthly flow measurements are made and used to calculate water balances, infiltration rates, and to distinguish baseflow from runoff along selected stream reaches Seeps are monitored for both flow and water-quality characteristics The resultant information will be used to better characterize groundwater flow and contamination plumes. The Surface-Water Management Plan (EG&G, 1991e) describes the data-collection program in some detail. The program is currently being revised to update the program and include suspended sediment characterization

Surface-Water Storage

The quantity of surface-water in storage at the RFP was estimated using available data In general, surface water in storage at the RFP is part of two systems: (1) water supply, wastewater disposal, and plant processes storage, or (2) surface-water pond storage. Both of these systems, along with the estimated water in storage at the RFP, are discussed below

Water in storage at any time is quite variable and depends upon the use for which the storage is designed Some potable water storage facilities are at or near their design storage capacity at all times Other surface-water storage facilities are empty nearly all the time except when being used to temporarily store water. Therefore, the capacities of the storage facilities can not be used as an indicator of water in storage at any particular time. For estimating the actual surface water in storage, it was assumed that each facility was at a percentage of its design capacity based upon historical observations of that facility The following estimates of surface water in storage at the RFP are preliminary and subject to change as more data become available The quantities of surface water in storage at the RFP generally represent an average annual condition at the RFP.

Water Supply, Wastewater Disposal, and Plant Processes Storage

The water supply, wastewater disposal, and plant-processes storage systems include raw water storage for the water treatment plant (Building 124), treated potable water, process water and wastewater, sanitary wastewater, and cooling towers The storage facilities within this system were assumed to be 75 percent full for purposes of estimating the water in storage

Table 2-12 summarizes the estimated water in storage for the water-supply, wastewater-disposal and plant-processes systems The STP has potential storage of about 410,000 gallons in both the Building 990 and Building 995 facilities. However, only about half, or 200,000 gallons, are in storage on a regular basis. The water treatment plant usually has about 1,160,000 gallons of water in storage, assuming it is at about 75 percent of the 1,550,000 gallon capacity The raw water storage pond, with a capacity of 1,500,000 gallons, was assumed to be full on a regular basis The cooling towers and process waste storage were assumed to be at capacity The total estimated water in storage in the water supply, wastewater disposal, and plant processes systems is estimated to be about 3,116,000 gallons

Surface-Water Pond Storage

The water stored in surface-water ponds at the RFP is primarily in man-made storage located in the Walnut Creek and Woman Creek basins. There are 12 ponds on the RFP that store storm runoff water and effluent from the STP These man-made storage ponds include the landfill pond, Ponds A-1 through A-4 in the North Walnut Creek basin, Ponds B-1 through B-5 in the South Walnut Creek basin, and Ponds C-1 and C-2 in the Woman Creek basin (Figure 2-25) Additional ponds in the southern portion of the RFP, formerly used for irrigation, no longer store water because they are breached

Table 2-12

Estimated Water in Storage Water Supply, Wastewater Disposal and Plant Processes System

Subsystem	Storage Capacity (Gallons)	Water in Storage* (Gallons)
Sewage Treatment Plant	410,000	200,000
Water Treatment Plant	1,550,000	1,160,000
Raw Water Storage Pond	1,500,000	1,500,000
Cooling Towers	220,000	220,000
Process Waste	36,000	36,000
TOTALS	3,716,000	3,116,000

* Represents annual average condition

Table 2-13 summarizes the approximate capacity of the 12 ponds and the estimated average amount of water in storage in each pond at any time The approximate spillway crest capacity for each pond was obtained from as-built drawings of the facilities. For comparison purposes, the spillway crest capacity reported by the U S Army Corps of Engineers (COE) (1989) also is presented In some cases the COE estimates do not agree with the as-built drawings The estimated water in storage was calculated by assuming that, in an average year, the ponds are about 40 percent full with respect to the spillway crest capacity as shown in the second column of Table 2-13. Pond C-2, an off-channel pond, was assumed to be only 25 percent of its spillway crest capacity. The total estimated water in storage in the RFP ponds is about 39,060,000 gallons The total estimated surface water in storage at the RFP is about 42 million gallons.

Table 2-13

Estimated Water in Storage Surface-Water System

Pond Identification[4)]	Approximate Spillway Crest Capacity (Gallons)	Spillway Crest Capacity[3)] (Gallons)	Estimated Water in Storage (Gallons)[1)]
Landfill	3,552,000	9,100,000	1,420,000
Pond A-1	1,600,000	1,600,000	640,000
Pond A-2	6,700,000	6,200,000	2,240,000
Pond A-3	14,110,000	14,000,000	5,600,000
Pond A-4	30,900,000	14,000,000[2)]	12,400,000
Pond B-1	795,000	1,000,000	320,000
Pond B-2	1,930,000	2,400,000	770,000
Pond B-3	620,000	720,000	250,000
Pond B-4	600,000	590,000	240,000
Pond B-5	23,140,000	26,000,000	9,260,000
Pond C-1	750,000	1,900,000	300,000
Pond C-2	22,490,000	23,000,000	5,620,000
TOTALS	107,187,000	100,510,000	39,060,000

1) Estimated average annual water in storage based upon approximate spillway crest capacity as given in column 2

2) As-built drawings show that this pond has a spillway capacity of 30,600,000 gallons

3) COE (1989)

4) See locations on Figure 2-25

ROCKY FLATS PLANT GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN	Manual No. Procedure No. Effective Date· Organization	21000-MP-GPMP 3 0, Rev 0 2/15/92 Environmental Management

Requirements for Groundwater Monitoring and Protection

Approved by·

J. W. Langman Jr. — Project Manager

2/18/92 — Date

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Reviewed for Classification /UCNI

By George H. Setlock

Date· 11/21/91 UNU

3.0 REQUIREMENTS FOR GROUNDWATER PROTECTION AND MONITORING

3.1 Technical Requirements

The RFP groundwater monitoring program is largely defined by Federal and State regulations and local requirements The overall goal of the groundwater program is to protect human health and the environment. In order to meet the program's intent, the RFP is free to take all actions deemed necessary that are consistent with, and meet the minimum requirements of the regulations and DOE orders imposed on the RFP To meet this goal, the program also should be capable of yielding useful and pertinent information so that decisions regarding sound management of the RFP groundwater resources can be made The technical requirements (some of which may be included or implied in regulatory or order requirements) are

- Groundwater resources must be protected,
- Geologic units at the RFP must be fully and appropriately identified;
- The influence of geologic units on groundwater flow must be identified,
- The direction and velocity of groundwater flow must be identified,
- Background, or uncontaminated, groundwater must be characterized,
- The presence, nature, and extent of plumes of contaminated groundwater must be identified,
- The presence and time-trend in groundwater contaminant movement must be determined,
- The interrelationship between the RFP's groundwater and surface-water resources must be qualitatively and quantitatively defined,
- The relationship between precipitation, infiltration, and groundwater must be qualitatively and quantitatively defined,

- The interconnectedness of various water-bearing media must be investigated, and

- Sources of groundwater contamination must be minimized

These are the basic requirements of the groundwater protection and monitoring program at the RFP Many technical requirements can be met by the implementation of the groundwater protection and monitoring program, however, fully addressing some of the technical requirements under study will require additional time and funding

3.2 Regulatory Requirements

Various orders, regulations, and agreements are presented in this section to determine their impacts on the groundwater protection and monitoring program

3 2 1 DOE Orders

Section III of DOE Order 5400 1 pertains to environmental protection plans The Groundwater Protection and Monitoring Program Plan (GPMPP), among the Special Programs of the Order, requires the following seven primary elements to be addressed in an adequate groundwater program for a DOE facility

1 Documentation of the groundwater regime with respect to quantity and quality,

2 Design and implementation of a groundwater monitoring program to support resource management and comply with applicable environmental laws and regulations,

3 A management program for groundwater protection and remediation, including SDWA, RCRA, and CERCLA actions,

4 A summary and identification of areas that may be contaminated with hazardous substances,

5 Strategies for controlling sources of these contaminants;

6 A remedial action program that is part of the site CERCLA program required by DOE Order 5400 4, and

7 Decontamination and decommissioning, and other remedial programs contained in DOE directives

This document addresses Chapter III, Section 4 a and Chapter IV, Section 9 of DOE Order 5400 1 These sections of DOE Order 5400 1 outline the following specific requirements of the GPMPP

- Description of existing or planned groundwater protection programs/plans,
- Identification of the organizational unit(s) that are responsible for preparation, annual review, and tri-annual updates, and
- Schedule for program and plan development and identification of budgetary resources required

Additionally, DOE Order 5400 1 requires groundwater monitoring program to be conducted onsite and in the vicinity of DOE facilities for the purposes of

- Obtaining data for characterizing baseline conditions of groundwater quality and quantity,
- Demonstrating compliance with and implementation of all applicable regulations and DOE Orders,
- Providing data to enable the early detection of groundwater pollution or contamination,
- Providing a reporting mechanism for suspected groundwater pollution or contamination,
- Identifying existing and potential groundwater contamination sources and maintaining surveillance through monitoring of these sources; and

- Providing data upon which decisions can be made concerning land-disposal practices and the management and protection of groundwater resources.

This plan documents and details the ongoing groundwater programs at the RFP that serve to fulfill the groundwater requirements of DOE Order 5400 1 Site-specific characteristics have been analyzed to determine monitoring needs Where appropriate, groundwater monitoring programs have been designed and implemented in accordance with 6 CCR 1007-3264, Subpart F (40 CFR 264, Subpart F), or 6 CCR 1007-3, 265 Subpart F (40 CFR 265, Subpart F) Monitoring of radionuclides is in accordance with 40 CFR 5400 Series DOE Orders which set forth regulations for protection of the public and the environment

Other DOE Orders pertaining to this document include DOE Orders 5400 2A, 5400.4, 5400 5, 5480 1, 5482 1, and 5484 1 These Orders provide groundwater monitoring and management requirements specific to individual environmental policies Within Order 5400 4 Paragraph 7b, CERCLA Requirements - Policy, the DOE, along with the Federal, State, and local entities are to execute feasibility studies and remedial actions as prescribed in DOE 5400 2A Order 5400 5, Radiation Protection of the Public and the Environment, Chapter II, Paragraph 3b, Discharges of Liquid Waste to Aquifers and Phaseout of Soil Columns, states that soil and groundwater are not acceptable receptacles for radioactive liquid waste streams Chapter II, Paragraph c, Management of Soil Columns, Natural Drainage Systems, and Groundwater at Inactive Sites Previously Contaminated with Radioactive Material decrees soil and groundwater that have been contaminated by liquid discharges will be managed or decontaminated pursuant to DOE Order 5480 14 [now 5400 4] Finally, Section IV, Paragraph b, Interim Storage, states that controls will be implemented to minimize the possibility that the concentrations of radionuclides in the groundwater exceed applicable Federal, State, and local standards at the time the property is released

3 2 2 Resource Conservation and Recovery Act (RCRA)

In general, groundwater monitoring under RCRA is similar to that under CERCLA, in that the primary objective of such a monitoring program is to assess the impact of a facility's operations on the groundwater beneath it There may be facility-specific groundwater monitoring requirements for a site under RCRA Interim Status or while undergoing closure or post-closure care In addition, facilities also are required to monitor the soil and groundwater in the vicinity of underground storage tanks containing petroleum products or hazardous materials as defined under Subtitle I.

RCRA requires that a hazardous waste treatment, storage, and disposal facility be treated as either an Interim Status or a Fully Permitted facility Hazardous waste is treated and stored at the RFP but is not disposed of onsite.

Interim Status facilities are those that were substantially in existence in 1981 or earlier for which a RCRA Part A Permit Application was filed in 1981 The RFP was granted Interim Status for most of its units in 1986 under the terms of the 1986 Compliance Agreement All land-disposal units granted Interim Status are to be retrofitted to meet RCRA Regulations or be closed under Interim Status by predetermined dates Interim Status facilities are regulated under 6 CCR 1007-3, Part 265 and 40 CFR Part 265. The RFP currently has only interim status units undergoing closure and site remediation that require groundwater monitoring Once a facility receives either an operating permit as a hazardous waste facility or a post-closure care permit, it is permitted under the corrective action provisions of RCRA for the purpose of site cleanup actions similar to those under CERCLA

RCRA groundwater monitoring requirements apply to owners and operators of surface impoundments, landfills, waste piles, and land treatment facilities used to manage hazardous waste These types of facilities are considered RCRA land disposal units for hazardous waste Groundwater monitoring at these units at RFP is required to comply with the Interim Status permit regulations at the current time. Monitoring is to be conducted at operating units from November 19, 1981 (one year after the effective date of the Interim Status regulations) (6 CCR 1007-3, 265 90)(40 CFR 265.90)), during the operating life of the facility, and throughout the post-closure care period (6 CCR 1007-3 265 117(a)(1) (40 CRF 265-117(a)(1))) This monitoring, which includes groundwater monitoring, must meet Post-Closure Care Requirements as defined by the RCRA regulations However, if all contaminants are removed from a RCRA land-disposal site at closure, the 30 years of post-closure monitoring and post-closure care may not be required The intent of the groundwater monitoring program is to assess the impact of the facility on the quality of groundwater in the uppermost aquifer underlying the facility in order to protect human health and the environment (6 CCR 1007-3, 265 90 (40 CFR 265 90)) There are provisions in the regulations for exemption from the groundwater monitoring requirements (40 CFR 265 90(c)). These exemptions require the owner/operator to provide a written demonstration that there is a low potential for migration of hazardous waste from the unit and that there is no harm to human health and the environment Such demonstrations are very difficult to prove

Certain land-disposal units are being phased out at the RFP These land disposal units are the Solar Evaporation Ponds which qualify as RCRA surface impoundments (6 CCR 1007-3, 265 197(b)(40 CFR 265 197(b))), the Present Landfill, which inadvertently accepted some RCRA-regulated wastes thereby qualifying as a RCRA landfill (6 CCR 1007-3, 260 10 (40 CFR 260 10)), and the West Spray Field, which was operated similar to a RCRA land treatment facility (6 CCR 1007-3, 260 10 (40 CFR 260 10)) The use of these units has or will cease and the sites will be investigated and remediated as required by the IAG All three of the above units were in at least partial operation one year after the effective date of the RCRA Interim Status regulations (November 19, 1981) and are therefore subject to the Interim Status groundwater monitoring requirements. The RFP is in the process of establishing compliance with Interim Status groundwater monitoring regulations (6 CCR 1007-3, 265 Subpart F (40 CFR 265 Subpart F)) and is progressing toward meeting all technical specifications of the Fully Permitted groundwater monitoring regulations (6 CCR 1007-3, 264 Subpart F (40 CFR 264 Subpart F)) at these units.

At the current time, the RFP Groundwater Protection Monitoring Program includes an Interim Status Groundwater Quality Assessment Program at the Solar Evaporation Ponds and an Interim Status Alternate Groundwater Monitoring System at the Present Landfill and West Spray Field The specific requirements of this program and system are detailed later in this section Most RCRA Interim Status facilities begin with an Initial Groundwater Monitoring Program at a site As long as groundwater contamination is not detected at such a site, no other groundwater monitoring program is required Because the RFP began RCRA groundwater monitoring at the majority of its RCRA sites in 1986, the Initial Groundwater Monitoring Program was not implemented at the RFP

The formerly-used Original Process Waste Lines (OPWL) are also considered a RCRA unit, but this unit does not require specific groundwater monitoring at this time because it has not been determined that this unit will be closed as a land-disposal unit Instead, the OPWL are monitored by other monitoring wells throughout the RFP In the event that contaminated soils associated with the OPWL cannot be removed or decontaminated, the RFP is required to comply with closure and post-closure care requirements for a landfill (6 CCR 1007-3, 265 197(b)(40 CFR 265 197(b))). The closure and post-closure care requirements for a landfill include complying with all applicable groundwater monitoring requirements (6 CCR 1007-3, 265 117(a)(1)(i) and (ii) (40 CFR 265 117(a)(1)(i) and (ii)), and 6 CFR 1007-3, 265 310(b)(2)(40 CFR 265 310(b)(2)))

A number of documents concerning the status and proposed requirements of the groundwater monitoring program have been submitted by the RFP operators to CDH and EPA These documents are Section E of the RCRA Part B Permit Application of November 26, 1986, Section E of the RCRA Post-Closure Care Permit Application of

November 26, 1986, the DOE Comprehensive Environmental Assessment and Response Program (CEARP), Installation Generic Monitoring Plan (IGMP), the DOE CEARP Site-Specific Monitoring Plan (SSMP), the RCRA Post-Closure Care Permit Application of October 7, 1988, the Groundwater Quality Assessment Plan of September 1989, the May 1990 Draft Addendum to the Groundwater Quality Assessment Plan of September 1989, and the January 22, 1991 IAG for the RFP Additionally, monitoring well installations and groundwater sampling related to site investigations are also described in the RCRA/CERCLA site investigation work plans and reports for the specific sites In September 1991, CDH transmitted comments to the RFP concerning the May 1990 Groundwater Assessment Plan Addendum These comments are currently being addressed It was determined that inclusion of Section E in the November 26, 1986 RCRA Part B Permit Application was inappropriate since a RCRA Part B Permit Application was not being requested for any hazardous waste land-disposal units. Later submittals of the RFP RCRA Part B Permit Application did not include Section E, the groundwater monitoring section After November 26, 1986, the applicable descriptions and plans for groundwater monitoring at the RFP are found in the DOE CEARP documents and the RCRA Post-Closure Care Permit Application, and the September 1989 and May 1990 RCRA groundwater documents

The other IHSSs at the RFP may be contaminated by hazardous waste or hazardous constituents but are not subject to RCRA groundwater monitoring requirements, because they were not in operation one year after the effective date of the RCRA Interim Status regulations They will be investigated and remediated as required in the IAG

Interim Status Groundwater Monitoring Requirements

As previously mentioned, components of the RFP groundwater monitoring program must comply with RCRA Interim Status regulations The regulations in 6 CCR 1007-3, 265 90(a) and (b) (40 CFR 265 90(a) and (b)) and 6 CCR 1007-3, 265 91 (40 CFR

265 91) represent the minimum requirements applicable to all facilities that require Interim Status groundwater monitoring

- The groundwater monitoring program must be capable of determining the facility's impact on the quality of groundwater in the uppermost aquifer underlying the facility (6 CCR 1007-3, 265 90 (40 CFR 265 90)).

- The groundwater monitoring system must be capable of yielding groundwater samples for analysis (6 CCR 1007-3, 265 91(a)(40 CFR 265 91(a)))

- The system must consist of at least one well hydraulically upgradient from the limit of the waste management area The number and location of upgradient wells must be sufficient to yield groundwater samples representative of background groundwater quality in the uppermost aquifer near the facility, and must not be affected by the facility (6 CCR 1007-3, 265 91(a)(1)(40 CFR 265 91(a)(1)))

- The system must consist of at least three wells hydraulically downgradient at the limit of the waste management area The number, location, and depths must ensure that they immediately detect any statistically significant amounts of hazardous waste or constituents that migrate from the facility to the uppermost aquifer (6 CCR 1007-3, 265 91(a)(2)(40 CFR 265 91(a)(2)))

- Monitoring wells must be cased in a manner that maintains the integrity of the monitoring wellbore hole This casing must be screened or perforated, and packed with gravel or sand where necessary, to enable sample collection at depths where appropriate aquifer flow zones exist The annular space must be sealed to prevent contamination of the samples and groundwater (6 CCR 1007-3, 265 91(c)(40 CFR 265 91(c)))

- The elevation of the groundwater in each monitoring well must be determined each time a sample is obtained (6 CCR 1007-3, 265 92(a) (40 CRF 265 92(e)))

Groundwater Quality Assessment Program

A Groundwater Quality Assessment Program must comply with the regulatory requirements of 6 CCR 1007-3, 265 93(40 CFR 265 93) If the groundwater analytical data from a unit under an initial groundwater monitoring system indicate that facility activities may be affecting groundwater quality, then groundwater quality assessment monitoring of the unit must begin The groundwater quality assessment program requires the facility to assess the concentrations and the rate and extent of migration of the hazardous constituents that have adversely affected groundwater These determinations must be made on a quarterly basis until final closure of the facility The first determinations under the groundwater quality assessment program must be made as soon as technically feasible Within fifteen days of that determination, a written report must be submitted to the CDH Director assessing the groundwater quality. Additionally, a report must be submitted to the CDH on an annual basis no later than March 1st following each calendar year until final closure of the unit The report shall include the results of the groundwater quality assessments

Alternate Groundwater Monitoring System

An Alternate Groundwater Monitoring System must comply with the regulatory requirements of 6 CCR 1007-3, 265 90(d)(40 CFR 265 90(d)) The purpose of the Alternate Groundwater Monitoring System is very similar to that of a Groundwater Quality Assessment Program An Alternate Groundwater Monitoring System can be proposed by the owner/operator when he assumes, or knows, that the results of analyses of groundwater indicator parameters in accordance with 6 CCR 1007-3, 265 91 (40 CFR 265 91) and 6 CCR 1007-3, 265 92(40 CFR 265 92) would show statistically significant increases in indicator parameters or decreases in the case of pH Indicator parameters include pH, specific conductance, total organic carbon, and total organic halogen.

Requirements of the Alternate Groundwater Monitoring System are to determine the concentrations of the hazardous constituents and the rate and extent of migration These determinations must be made on a quarterly basis until final closure of the facility. The first determinations under the alternate groundwater plan must be made as soon as technically feasible Within fifteen days of that determination, a written report must be submitted to the CDH Director and the EPA Regional Administrator who assess groundwater quality Additionally, a report must be submitted to the CDH on an annual basis until final closure, and no later than March 1st following each calendar year The report will include the results of the alternate groundwater assessments

Recordkeeping for Assessment and Alternate Monitoring Systems

The recordkeeping and reporting requirement for groundwater assessment and alternate monitoring programs are specified in 6 CCR 1007-3, 265 94(b) (40 CFR 265 94(b)). Recordkeeping and reporting requirements for the RFP alternate and assessment monitoring programs are identified below

- The owner/operator must keep records of the analyses and evaluations specified in the groundwater quality assessment program or alternate monitoring program throughout the life of the facility and the post-closure care period (6 CCR 1007-3, 265 94(b)(1) (40 CFR 265.94(b)(1))).

- Quarterly determinations must be made of the rate and extent of migration of hazardous waste or hazardous waste constituents The concentration of hazardous waste or hazardous waste constituents must also be determined as a part of the quarterly determinations (6 CCR 1007-3, 265 90(d)(4) (40 CFR 265 90(d)(4) and 6 CCR 1007-3, 265 93(d)(4) (40 CFR 265 93(d)(4))).

- Until final closure of the facility, the owner/operator must submit an annual report containing the results of the groundwater quality assessment program or alternative monitoring program This report must include, but is not limited to, the calculated or measured rate of migration of hazardous waste or hazardous waste constituents in the groundwater during the reporting period This information must be submitted no later than March 1st following each calendar year (6 CCR 1007-3, 265 94(b)(2) (40 CFR 265 94(b)(2)))

Fully Permitted/Post-Closure Care Requirements

So called fully-permitted groundwater monitoring requirements are detailed in 6 CCR 1007-3, 264 Subpart F (40 CFR 264 Subpart F) and will become applicable to the RFP at some time in the future These regulations require that a Fully Permitted facility's monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depth Designated wells must yield groundwater samples from the uppermost aquifer underlying the facility that

- Represent the quality of background water that has not been affected by leakage from a regulated unit,
- Represent the quality of groundwater passing the point of compliance, and
- Allow for the detection of contamination when hazardous waste or hazardous constituents have migrated from the waste management area to the uppermost aquifer

According to the regulations, a Fully Permitted facility's groundwater monitoring program must, at all times, comply with the requirements of one of the following types of groundwater monitoring programs Detection Monitoring Program, Compliance Monitoring Program, or Corrective Action Program Fully Permitted facilities are also subject to the Corrective Action Requirements for SWMUs

A number of elements are common to all of the above programs These common elements are listed below

- The Point of Compliance for RCRA-regulated units is specified by CDH. It is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units (6 CCR 1007-3, 264 95(a) (40 CFR 264 95(a))) The waste management area is the limit projected in the horizontal plane of the area on which waste will be placed during the active life of a regulated unit. The waste management area includes space taken up by any liner, dike, or other barrier designed to contain waste The waste management area may be shown by an imaginary line circumscribing several regulated units

- Monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole This casing must be screened or perforated, and packed with gravel or sand where necessary, to enable collection of groundwater samples The annular space must be sealed above the sampling depth to prevent contamination of the samples and groundwater (6 CCR 1007-3, 264 97(c) (40 CFR 264 97(c)))

- The groundwater monitoring program must include consistent sampling and analysis procedures designed to ensure monitoring results that provide a reliable indication of groundwater quality below the waste management area At a minimum, the program must include procedures and techniques for the following (6 CCR 1007-3, 264 97(d) (40 CFR 264 97(d)))

    - sample collection,
    - sample preservation and shipment,
    - analytical procedures, and
    - chain-of-custody control

- The groundwater monitoring program must include sampling and analytical methods appropriate for groundwater sampling and that accurately measure hazardous constituents in groundwater samples (6 CCR 1007-3, 264.97(e) (40 CFR 264 97(e)))

- The groundwater monitoring program must include a determination of the groundwater surface elevation each time the groundwater is sampled (6 CCR 1007-3, 264 97(f) (40 CFR 264 97(f)))

- The RFP owner or operator must specify the statistical procedures used in the evaluation of groundwater data for each hazardous constituent (6 CCR 1007-3, 264 97(g) (40 CFR 264 97(g)))

- Groundwater data must be available at the facility for review and maintained in the facility operating records (6 CCR 1007-3, 264 97(e) (40 CFR 264 97(j)))

Details of the specific monitoring programs follow

Detection Monitoring Program

A detection monitoring program must comply with the requirements of 6 CCR 1007-3, 264 98 (40 CFR 264 98) A detection monitoring program is used when it is believed that a regulated unit has not, and is not, impacting groundwater quality. The program must be capable of determining whether a release from the unit has taken place at the point of compliance The location of the point of compliance is specified in CDH regulations. Should a release from the unit be detected, the facility must institute a compliance monitoring program The compliance monitoring program is used to determine whether the groundwater protection standard has been exceeded at the point of compliance.

Compliance Monitoring Program

A compliance monitoring program must comply with the requirements of 6 CCR 1007-3, 264 99 (40 CFR 264 99) The compliance monitoring program is implemented after a hazardous constituent has been detected in groundwater at the point of compliance. The intent of the compliance monitoring program is to assess whether the regulated units are in compliance with the groundwater protection standard The groundwater protection standard is designed to ensure that hazardous constituents detected in groundwater of the uppermost aquifer do not exceed the groundwater protection standard concentration limits beyond the point of compliance during the compliance period (6 CCR 1007-3, 264 92 (40 CFR 264 92)) The following are the elements of a groundwater protection standard

- A list of hazardous constituents which are identified in Appendix VIII of 6 CCR 1007-3 Part 261 (40 CFR Part 261)
- Concentration limits for hazardous constituents The concentration of a hazardous constituent should.

- Not exceed the background level of that constituent at the time the limit is specified (6 CCR 1007-3, 264 94(a)(1) (40 CFR 264 94(a)(1))), or

- Not exceed the levels given in Table 3-1 if the background level of the constituent is below the value given in Table 3-1 (6 CCR 1007-3, 264 94(a)(2) (40 CFR 264 94(a)(2))), and

- Not exceed an alternate limit established by the Regional Administrator (6 CCR 1007-3, 264 94(a)(3) (40 CFR 264 94(a)(3))).

- Concentration limits for the regulated units at the RFP were specified in the May 1990 Addendum to the Groundwater Assessment Plan of September 1989 The proposed concentration limits are presented in Table 3-2.

- An identification of the compliance point (6 CCR 1007-3, 264 99(a)(3) (40 CFR 264 99(a)(3)))

- An identification of the compliance period (6 CCR 1007-3 264 99(a)(4) (40 CFR 264 99(a)(4)))

If it is found that the groundwater protection standard is exceeded at the point of compliance or downgradient of the point of compliance, then corrective actions must be taken, and a corrective action groundwater monitoring program must be implemented.

Corrective Action Program

A corrective action program must comply with the requirements of 6 CCR 1007-3 264 100 (40 CFR 264 100) The intent of the corrective action program is to prevent hazardous constituents from exceeding their respective concentration limits at the compliance point by removing the hazardous constituents or by treating them in situ. A corrective action program also must be implemented in order to demonstrate the effectiveness of the groundwater corrective actions The corrective action monitoring program must be at least as effective as a compliance monitoring program in the determination of compliance with the groundwater protection standard Upon completion of the statistical analysis, a corrective action program will be outlined and submitted for approval.

Table 3-1

Maximum Concentration of Constituents for Groundwater Protection[1]

Constituent	Concentration[2]
Arsenic	0 052
Barium	1 00
Cadmium	0 01
Chromium	0 05
Lead	0 05
Mercury	0 002
Selenium	0 01
Silver	0 05
Endrin (1,2,3,4,10, 10-hexachloro-1, 7-epoxy-1,4,4a,5,6,7,8,9a-octahydro-1 4-endo, endo-5,5-dimethano naphthalene	0 0002
Lindane (1,2,3,4,5,6-hexachloroclohexane, gamma isomer)	0 004
Methoxychlor (1,1,1-Trichloro-2,2-bis p-methoxyphenylethane)	0 1
Toxaphene ($C_{10}H_{10}Cl_2$ Technical chlorinated camphene, 67-69 percent chlorine)	0 005
2,4-D (2,4-Dichlorophenoxyacetic acid)	0 1
2,4,5-TP Silvex (2,4,5-Trichlorophenoxy-propionic acid)	0 01

1) Source 6 CCR 1007-3, 264 94(a)(2) Table 1
2) Milligrams per liter

selection of appropriate response alternatives (6 CCR 1007-3 Section 300.43 and 40 CFR 300 43)

Characterization of the site hydrogeology involves identifying geologic characteristics, hydraulic properties, and groundwater use Though some information may be obtained from existing literature, a full characterization usually requires the installation of a network of monitoring wells and piezometers If contamination of an aquifer is a possibility, a groundwater monitoring program should be implemented The placement of wells should be in the direction of groundwater flow, in aquifers subject to contamination, and in places where the wells would indicate an existing or future threat to receptor populations Because of the uncertainties associated with subsurface migration, sampling should also be done in the area upgradient of the contaminant source

Developing, Assessing, and Selecting Remediation Alternatives

Once the nature and extent of the contamination are characterized, the FS process develops alternatives for remediation Combinations of technologies and the media through which they would be applied are assembled into alternatives that address contamination on a site-wide basis or for an identified operable unit. For groundwater response actions, alternatives should address not only cleanup levels but also the time frame within which the alternatives might be achieved Detailed information for developing remedial alternatives for groundwater response actions may be found in "Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites" (EPA August 1988, OSWER Directive No 9283 1-2) The policies outlined in this document focus on the restoration of contaminated groundwater ARARs to be considered in the screening of remedial alternatives include, but may not be limited to·

1) Title XIV, Part C of the Safe Drinking Water Act, Underground Injection Control (UIC) Program - Regulates underground injection of hazardous waste.

Table 3-1

Maximum Concentration of Constituents for Groundwater Protection[1]

Constituent	Concentration[2]
Arsenic	0.052
Barium	1 00
Cadmium	0 01
Chromium	0 05
Lead	0 05
Mercury	0 002
Selenium	0.01
Silver	0 05
Endrin (1,2,3,4,10, 10-hexachloro-1, 7-epoxy-1,4,4a,5,6,7,8,9a-octahydro-1 4-endo, endo-5,5-dimethano naphthalene	0 0002
Lindane (1,2,3,4,5,6-hexachloroclohexane, gamma isomer)	0 004
Methoxychlor (1,1,1-Trichloro-2,2-bis p-methoxyphenylethane)	0 1
Toxaphene ($C_{10}H_{10}Cl_2$ Technical chlorinated camphene, 67-69 percent chlorine)	0 005
2,4-D (2,4-Dichlorophenoxyacetic acid)	0 1
2,4,5-TP Silvex (2,4,5-Trichlorophenoxy-propionic acid)	0 01

1) Source 6 CCR 1007-3, 264 94(a)(2) Table 1
2) Milligrams per liter

Table 3-2

Proposed Groundwater Concentration Limits

CONSTITUENT		CONCENTRATION
Dissolved Metals (mg/L)		
	++Ag	BKG*
	Al	5 0
	++As	0 05**
	++Ba	1 0**
	+Be	BKG
	Ca	NS
	++Cd	0 01**
	+Co	BKG
	++Cr	0.05**
	Cs	BKG***
	+Cu	BKG
	Fe	0.03**
	++Hg	0 002
	K	NS
	+Li	BKG
	Mg	NS
	Mn	BKG*++
	Mo	0 1++*
	Na	NS
	+Ni	BKG
	++Pb	0 05**
	+Sb	BKG
	++Se	0 01**
	Sr	BKG***
	+Ti	BKG
	+V	BKG
	+Zn	BKG
Other Inorganics (mg/L)		
	Cl	250**+
	SO_4	250**+
	NO_3	10**+
	TDS	400++*

Table 3-2 (continued)

Proposed Groundwater Concentration Limits

CONSTITUENT	CONCENTRATION
Dissolved Radionuclides (pCi/L)	
Gross Alpha	11**+
Gross Beta	19**+
Pu 239, 240	0.05**+
Am 241	0 05**+
Total Uranium	5**+
Sr 89, 90	78++*
Cs 137	NS
^{3}H	500**+

*	Based on upper limit for background range
**	Primary Drinking Water Standard
***	Although not 6 CCR 100 7-3 261 Appendix VIII constituents, health based standards do not exist and therefore the proposed concentration limit for cesium and strontium is background
*++	Unweathered sandstone groundwater has a background concentration (upper limit of range) less than 0.05 mg/L, the CDH groundwater standard Therefore, for this groundwater the CDH standard is proposed
**+	Colorado Surface-Water Standard
++*	Colorado Groundwater Standard
+	6 CCR 1007-3 261 Appendix VIII constituent
++	6 CCR 1007-3 261 Appendix VIII constituent and SDWA metal
BKG	Background
NS	No standard

Source 1990 Addendum to the Groundwater Assessment Plan of September 1989 (Hg was modified from this reference to reflect 6 CCR 1007-3 261 Appendix VIII)

Corrective Action for Solid Waste Management Units (SWMUs)

Corrective action for SWMUs must comply with the requirements of 6 CCR 1007-3, 264 101 (40 CFR 264 101) as required in the IAG In general, these requirements specify that the RFP " must institute corrective action as necessary to protect human health and the environment for all releases of hazardous wastes or constituents from any solid waste management unit at the facility, regardless of the time at which waste was placed in such units " The following are elements of the corrective action program for SWMUs

- Schedules for corrective action must be specified;
- Financial responsibility for corrective action must be assured, and
- Corrective actions must be implemented beyond the facility boundaries where necessary to protect human health and the environment.

3 2 3 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

Clean-up standards applicable to Federal facilities are set forth in Section 121 of CERCLA For sites on the National Priorities List (NPL), the requirements are relatively clear All legally applicable or relevant and appropriate requirements (ARARs) of Federal environmental laws, and those requirements contained in State environmental laws that are more stringent than Federal ARARs, must be applied to remedial actions at Federal sites The ultimate selection of cleanup standards is discretionary and involves a determination by Federal, State, and local regulations of what requirements are appropriate for remediation of the site In other words, virtually any Federal or State law dealing with groundwater, surface water, or drinking water may be considered a regulatory requirement under CERCLA

Requirements Under the Investigatory Phase

Section 105 of CERCLA, as amended by Superfund Amendment and Reauthorization Act (SARA) Section 105, requires that the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) (6 CCR 1007-3, Part 300 (40 CFR Part 300)), developed under the Clean Water Act (CWA), be revised to include procedures and standards for responding to releases of oil and hazardous substances Subpart E of the NCP, Hazardous Substance Response, establishes a seven-phase approach for determining the appropriate extent of a response authorized by CERCLA when any hazardous substance is released into the environment, or there is a release of any pollutant or contaminant that may present an imminent and substantial danger to the public health or welfare

The investigatory phases of the NCP, the Preliminary Assessment/Site Investigation (PA/SI), are primarily a data gathering exercise and usually do not require groundwater monitoring If necessary to confirm the presence of contaminants, sampling may be conducted, but a complete characterization of the nature and extent of the contamination would not be done at this time If the PA/SI indicates that contaminants are present and may potentially threaten human health or the environment, a Hazard Ranking System (HRS) package is prepared Based on the site's HRS score, the site is proposed for inclusion on the National Priorities List (NPL) The Remedial Investigation/Feasibility Study (RI/FS) is the first step toward site characterization and remedial alternative selection

The RI involves an exhaustive characterization of the nature and extent of the contamination Even if there is no evidence of groundwater contamination, an investigation of the site hydrogeology is required to provide information to assess the risks to human health and the environment and to support the development, evaluation, and

2) Part C, of the SDWA, Section 1427(e), Sole Source Aquifer Demonstration (SSAD) Program - Protects aquifers that are the sole or principal drinking water source for an area

3) Part C, of the SDWA, Section 1428, Groundwater Protection Program - Protects wells and recharge areas supplying public drinking water from subsurface contamination

4) CERCLA Section 104(c)(6) - Defines remedial action to include the operation of measures to restore contaminated groundwater or surface water for a period of up to 10 years after the commencement of operation of such measures.

Post-Closure Monitoring and Routine Verification of Remediation

In general, any remedial activities other than clean closure require groundwater monitoring to ensure that contaminants are not being released Any corrective action that allows contaminants (RCRA or otherwise) to remain on-site requires groundwater monitoring unless such monitoring is clearly not justified

Performance monitoring may also be required to verify that remediation is being performed as intended For instance, a system to pump, treat, and return groundwater would require downgradient groundwater monitoring to verify cleanup

3 2 4 Federal Facility Compliance Agreement (FFCA)

The NPDES FFCA for the RFP was signed by DOE and EPA on March 25, 1991 Groundwater protection components of this agreement involve the STP sludge-drying beds and an implementation plan to control unplanned releases pending review by EPA The first component provides a groundwater monitoring plan for the areas around the sludge-drying beds, however, modifications to the proposed plan include vadose-zone monitoring and a more selective chemical-constituent list for monitoring The second component involves activities to prevent unplanned contaminant releases These are part of a corrective action plan developed as a result of an incident at the RFP involving a chromic-acid release through the STP These actions further improve controls over contaminant sources that potentially threaten groundwater resources Examples include building-drain studies, review of secondary containment around tanks, and verification that no undocumented sanitary or storm-sewer connections exist

3 2 5 Clean Water Act (CWA)/National Pollutant Discharge Elimination System (NPDES)

The primary responsibility for compliance with NPDES requirements is assigned to the Surface-Water Division of EG&G The CWA and NPDES permitting activities are peripherally related to groundwater issues This is because surface water and groundwater interreact and are interrelated Other relevant investigations resulting in part from NPDES activities include proposed STP upgrades and NPDES-related detention-pond maintenance procedures (such as dam hardening, removal of sediments, etc). Components of some of these investigations could impact groundwater at the RFP by affecting the quantity and rate of recharge to the uppermost aquifers The potential impacts of contaminated groundwater on surface water must also be investigated in order to adequately protect surface water from contamination These investigations are being conducted under the IAG cleanup process

3.2.6 National Environmental Policy Act (NEPA)

NEPA declares a national environmental policy and promotes consideration of environmental concerns for Federal agencies The implementation of documentation requirements for NEPA at the RFP are guided by DOE Order 5440 1C, Secretary of Energy Notice SEN-15-90 (02/05/90), and the Draft DOE NEPA Compliance Guide (10/85) Further, implementation of these external requirements is accomplished in accordance with the RFP procedure EMM-0800-1, "Implementation of Documentation Requirements for NEPA "

These requirements will be referenced to determine the level of NEPA documentation required to document the existing conditions at any particular IHSS or OU. Information pertaining to the presence of contamination in the environment will be documented through the NEPA policies

Alternative actions will also be discussed in the NEPA documentation process, thereby ensuring sufficient information is available for decision making regarding the IHSS or OU

3 2 7 Agreement in Principle (AIP)

The AIP signed by DOE and the State of Colorado on June 28, 1989 requires that DOE provide the resources for independent sampling by the CDH It also allows for review of and comment on the RFP monitoring programs by CDH Sampling involves surface water and groundwater done both routinely and on specific occasions Split samples will be taken of discharge water and pond water while routine samples will be taken of boundary wells and city drinking waters Additionally, the AIP specifies activities which will promote the understanding of the impact the RFP has had on the environment The following is an outline of AIP requirements

Surface Water

- Routine sampling of drinking water from Broomfield, Westminster, Thornton, and Northglenn
- Routine sampling of Great Western Reservoir and Standley Lake
- Sampling of the RFP water prior to any discharges
- Periodic biomonitoring of discharge water
- Sampling of all discharges

Groundwater

- CDH review of existing groundwater program and recommendations for improvements

- CDH/EPA's and local communities' continued review of groundwater data

- CDH periodically sampling of boundary wells.

- DOE expedition of CDH/EPA-recommended improvements to the groundwater program during 1989

3 2 8 Inter-Agency Agreement (IAG)

The IAG was signed by the CDH, EPA, and DOE on January 22, 1991 It is an agreement among the regulators that describes the site investigation and characterization activities that will be performed at the RFP The document presents a unique blend of RCRA and CERCLA requirements Future groundwater monitoring and characterization activities will comply with requirements of the IAG

The general purposes of the IAG are to

- Ensure environmental impacts associated with past and present activities at the RFP will be thoroughly investigated and the appropriate response action taken to protect public health, welfare, and the environment,

- Facilitate cooperation of the parties involved in the operations of the RFP;

- Establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at the RFP in accordance with CERCLA, RCRA, and CHWA

- Provide a framework for permitting RCRA units and promote an effective investigation and cleanup of contamination, and

- Ensure compliance with RCRA and CHWA

The specific purposes of the IAG are to

- Identify IM/IRAs,
- Identify any treatment, storage, or disposal units that require permits and closure,
- Establish requirements for the performance of a RI/RFI for each OU to determine fully the nature and extent of the threat to public health or welfare or the environment caused by the OU and to establish requirements for the performance of a FS/CMS for each OU;
- Identify the nature, objective, and schedule of response actions to be taken;
- Implement the selected IM/IRAs and final remedial/correction actions,
- Assure compliance with Federal and State hazardous waste laws and regulations,
- Describe the roles and responsibilities of the parties,
- Provide for continued operations and maintenance of the selected remedial/corrective action(s), and
- Provide for interactive community involvement in the initiation, development, and selection of remedial actions to be undertaken

Included in the IAG is a detailed Statement of Work (SOW) which sets forth the elements of work required to be performed in response to all hazardous substance releases or threats of releases which may cause harm to human health or the environment. An outline of the work to be performed during the investigatory and study phase (e g. RI/FS, RFI/CMS) of the response process is presented The SOW includes general response procedures which delineate the process of investigation, characterization, and remediation of discrete locations of the RFP This will enable the RFP to proceed toward the objective of protecting public health, welfare, and the environment Detailed tables are attached to the SOW which state required actions and schedules for the phases of investigation of each OU

3 2 9 Water Quality Control Commission Site-Specific Standards

On March 15, 1991, the Water Quality Control Commission (WQCC) for Colorado adopted site-specific groundwater quality standards for the RFP Notice of Final Adoption for the WQCC Standards is included as Appendix D of this report. These regulations became effective on April 30, 1991 These regulations apply to:

> "All unconfined groundwater within the saturated zone of the unconsolidated Quaternary aquifer, the Rocky Flats aquifer, the Arapahoe aquifer, and the Laramie-Fox Hills aquifer," at the RFP (WQCC, 1991)

The specific standards were identified on six tables, reproduced in Appendix D. The groundwater classifications and standards applicable within the RFP were specified as:

1 Quaternary and Rocky Flats Aquifers

- Domestic Use-Quality
- Agricultural Use-Quality
- Surface Water Protection (WQCC, 1991)

2 Arapahoe and Laramie-Fox Hills Aquifers

- Domestic Use-Quality
- Agricultural Use-Quality (WQCC, 1991)

The standards identified in Tables 1 through 4 of Appendix D are applied state-wide to the respective classifications of groundwater The RFP is the only area where these classifications have yet been applied The water quality standards identified in Tables 5 and 6 of Appendix D are applicable to groundwater in the quaternary and Rocky Flats Aquifers The radionuclide standards in Table 6 are applicable standards for all groundwaters hydraulically connected to Woman or Walnut Creeks (WQCC, 1991). In addition to the above site specific standards, the WQCC also adopted state-wide groundwater standards on September 20, 1990 that were effective on October 30, 1990.

These state-wide groundwater standards are reproduced in Tables 7-9 in Appendix D. The RFP is attempting to meet these WQCC site-specific and state-wide standards in all waters to which they are applicable However, there remain unresolved issues as to whether these site-specific and state-wide standards are legally enforceable and/or of general applicability

3 2 10 External Recommendations

The groundwater monitoring program at the RFP is also influenced by a number of external, Federal, and State regulatory requirements Specific external recommendations include those suggested by the Governor's Rocky Flats Scientific Panel on Monitoring Systems, and the RFP Environmental Monitoring Council. Separate from State and Federal requirements, the RFP has agreed to follow recommendations set forth by these groups The primary recommendations of these groups include expanded monitoring and public involvement

Governor's Rocky Flats Scientific Panel on Monitoring Systems

The Governor's Rocky Flats Scientific Panel on Monitoring Systems was assigned by the Governor of Colorado to serve as an advisory board to the Governor on scientific issues relating to the RFP The panel reviewed and commented on DOE and CDH monitoring programs at the RFP Thirty-one recommendations were made for modifications to the RFP monitoring programs Specific recommendations relevant to groundwater/surface water monitoring at the RFP include the following

- Identify and document information objectives for the monitoring program
- Computerize data collection and analysis
- Implement a Quality Assurance/Quality Control (QA/QC) program.

- Do additional background data collection and analysis
- Implement state-of-the-art technologies.
- Delete wells without complete documentation from the monitoring program
- Analyze the nearest domestic water use well downstream for plutonium.
- Implement use of a mobile sampling van.

<u>Rocky Flats Environmental Monitoring Council</u>

The Rocky Flats Environmental Monitoring Council was formed to represent the public interest concerning Rocky Flats Their goal is to maintain the health and safety of the surrounding communities and the environment Monthly meetings are held to exchange information with the RFP environmental personnel Overall, the group puts itself in an oversight role and places the following requests on the RFP environmental programs:

- Provide full communication with the public regarding issues
- Provide opportunities for meaningful public involvement in decision making
- Ensure that information dissemination, regulatory compliance, and oversight is credible
- Ensure full financial and other commitments to meet health and safety and environmental goals, regardless of production needs or other factors.

3.3 Summary of Order Influence/Requirements on Groundwater Monitoring

The foregoing detailed review of the requirements applicable to the groundwater program defines criteria with which the RFP groundwater program must comply Briefly stated, these requirements are summarized as follows:

General Requirements

- Groundwater resources must be protected.
- The geologic units at the RFP must be fully and appropriately characterized.
- The influence of geologic units on groundwater flow must be identified.
- The direction and velocity of groundwater flow must be identified.
- Background, or uncontaminated, groundwater must be characterized.
- The presence, nature, extent, and migration of contaminate plumes must be identified

Water Interactions

- The interrelationship of groundwater and surface water should be qualitatively and quantitatively defined.
- The relationship between precipitation, infiltration, and groundwater should be qualitatively and quantitatively defined.
- The interconnectedness of various water-bearing media must be investigated

Plume Characterization

- Sources of groundwater contamination must be eliminated.
- The early detection of groundwater pollution or contamination must be ensured
- Provide for quarterly analysis of groundwater data.
- Provide for quarterly determination of the rate and extent of contaminant migration

- Provide for quarterly determination of the concentrations of hazardous waste and hazardous waste constituents in groundwater.

- A minimum of annual reporting of groundwater data must be made and due March 1st of each year for the preceding year.

- Data needed for site characterization and remediation should be generated

Other Requirements

- A plan for investigation of groundwater contamination at the STP sludge-drying beds should be prepared and implemented.

- A plan for NPDES-related activities dealing with unplanned contaminant releases should be prepared.

- Data needed in NEPA compliance activities to adequately evaluate the environmental differences between the "No Action" alternative and other remedial action alternatives should be compiled

Program Requirements

- Data collection and analysis should be computerized

- QA/QC for the program should be improved

- Additional background analyses should be implemented.

- Wells with incomplete documentation should be deleted from the program.

- The nearest downstream wells should be sampled for appropriate constituents

- Communication should be provided to the public about issues

None of the above identified requirements are contradictory to existing Federal or State regulations All of the identified requirements have been addressed and are included in either the GPMPP or some other ongoing program at the RFP

ROCKY FLATS PLANT	**Manual No :**	**21000-MP-GPMP**
GROUNDWATER PROTECTION	**Procedure No..**	**4 0, Rev 0**
AND MONITORING PROGRAM PLAN	**Effective Date:**	**2/15/92**
	Organization.	**Environmental Management**

Description of Existing Groundwater Protection Monitoring Program Plan

Approved by

J. W Langman Jr. 2/18/92

Project Manager **Date**

This is a
CONTROLLED DOCUMENT
— ROCKY FL
ENVIRONMENTAL MANAGE DEPARTMENT
This is a RED Stamp

Reviewed for Classification /UCNI

By: George H. Setlock

Date 11/21/91 UNU

4.0 DESCRIPTION OF THE GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

4.1 Program Organization

The EG&G, Rocky Flats, Inc management organization for the GPMPP at the RFP is given in Figures 4-1 and 4-2 The DOE table of management organization for GPMPP at the RFP is provided in Figure 4-3

4.2 Groundwater Protection Program

4 2 1 Definition of Protection

The definition of groundwater protection at the RFP is the prevention, monitoring, and remediation of contaminated groundwater in the vicinity of the plant. The goals of the Groundwater Protection Program are the protection of groundwater at the RFP from overdevelopment, protection from new sources of contamination, and to generate data that support the identification and remediation of existing contamination present in groundwater In essence, protection will result in the preservation of the groundwater resource at the RFP from loss or degradation Protection of groundwater resources is considered to be desirable whether or not the groundwater is actively used as a resource. In addition to these broader goals, all regulatory and technical requirements detailed in the previous sections of this document must be considered and addressed as a part of the Groundwater Protection Program In a larger sense, the requirements placed on the Groundwater Protection Program by both the program goals and the regulatory requirements can be summed up by stating that knowledge of the physical and chemical characteristics of the geologic media in which groundwater flows and the physical and chemical nature of groundwater is needed in order to protect this resource

General Manager
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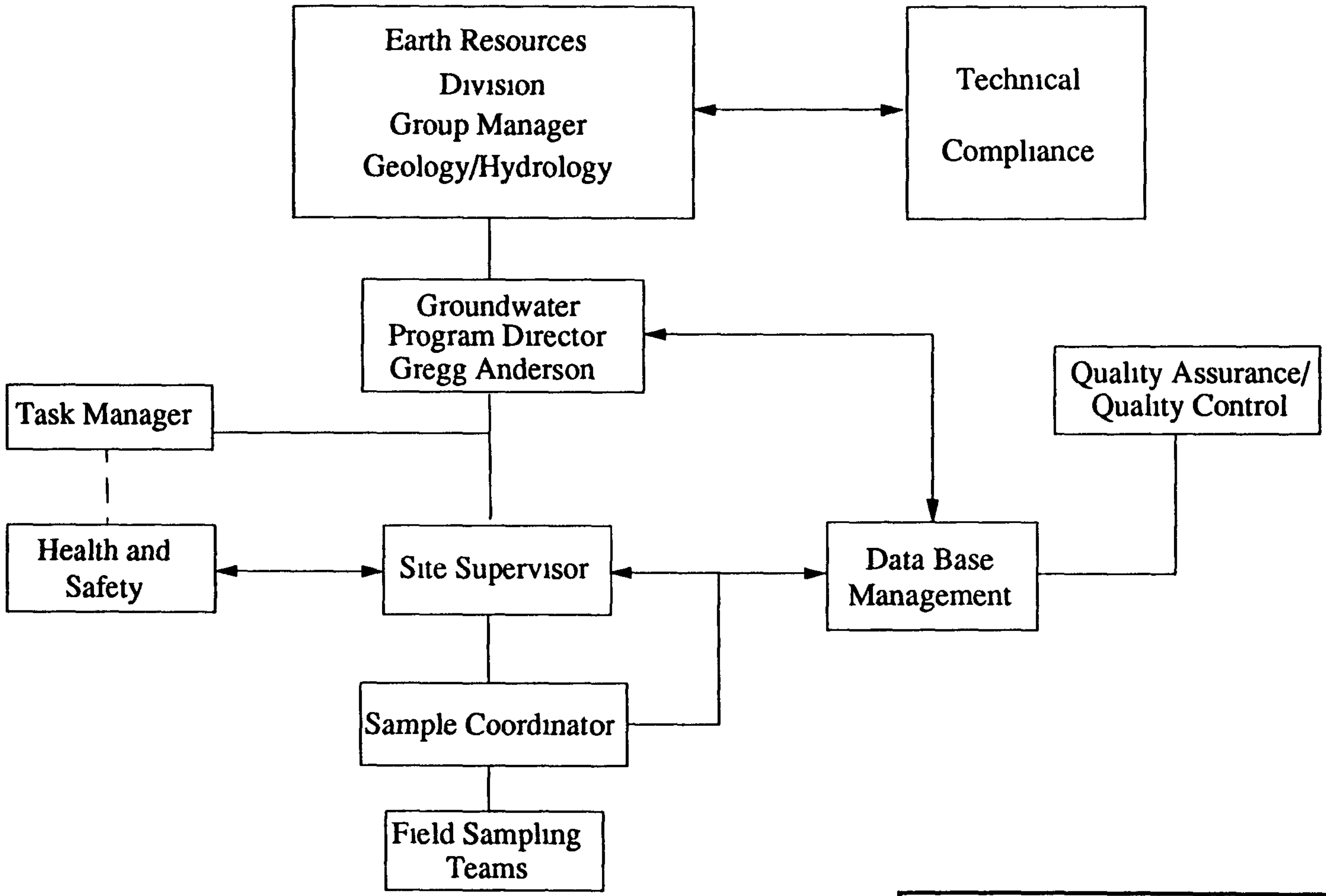
EG&G ROCKY FLATS, INC.
MANAGEMENT ORGANIZATION

GROUNDWATER PROTECTION
AND MONITORING PROGRAM PLAN

EG&G
Rocky Flats Plant, Golden, Colorado

FIGURE 4-1

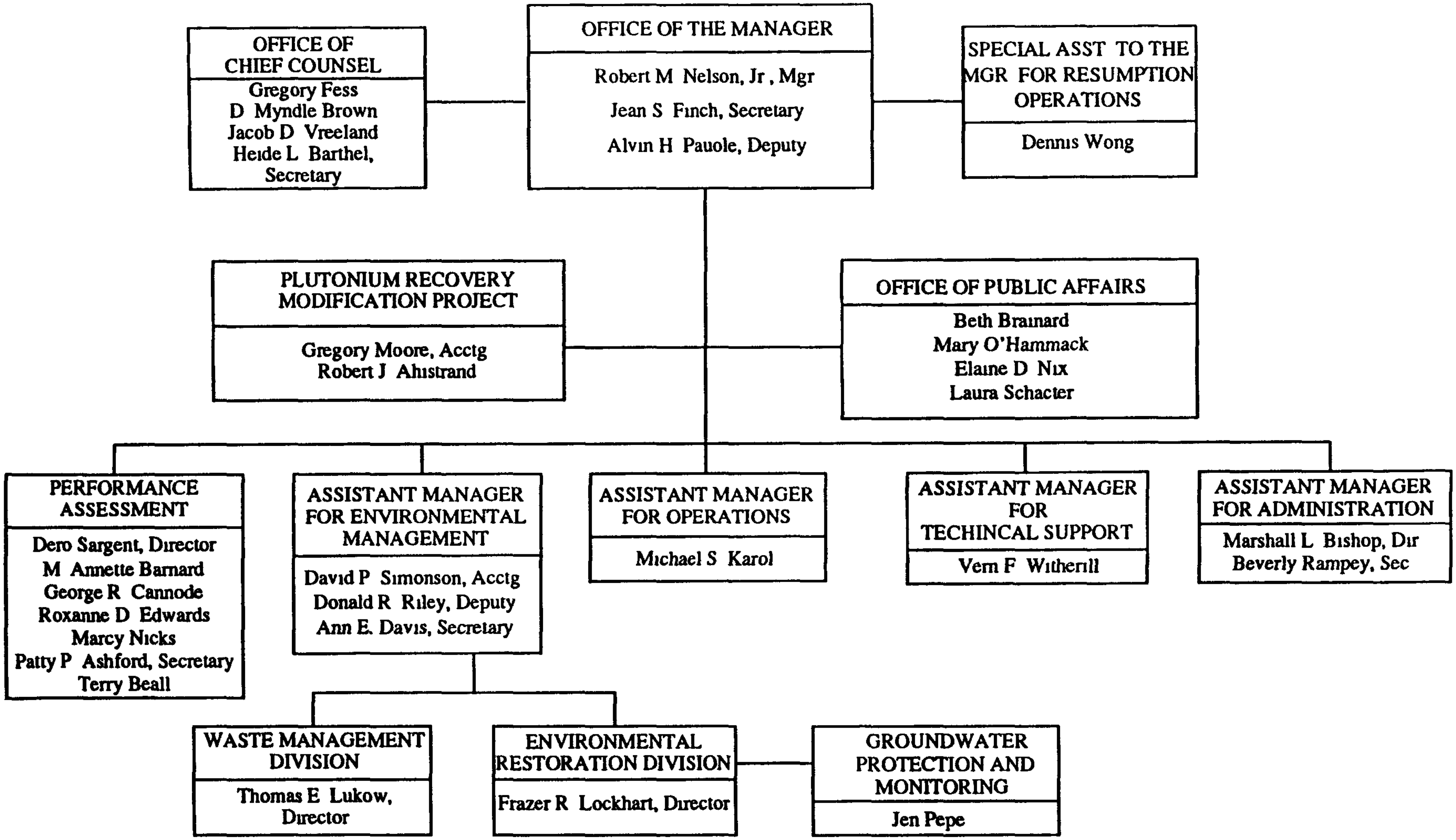


GROUNDWATER MONITORING
PROGRAM ORGANIZATION

GROUNDWATER PROTECTION
AND MONITORING PROGRAM PLAN

EG&G
Rocky Flats Plant, Golden, Colorado

FIGURE 4-2



DEPARTMENT OF ENERGY ORGANIZATION

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

EG&G
Rocky Flats Plant, Golden, Colorado

FIGURE 4-3

These differences among components of the overall groundwater monitoring program are known primarily to the various managers responsible at the RFP for certain monitoring or remediation activities In this manner, an overall (comprehensive) protection program serves the needs of a number of broad program goals in addition to the specific information needs of a number of project managers Groundwater and surface water monitoring activities are a subset of this overall Groundwater Protection Program. A brief discussion of the broad goals and the portions of the Groundwater Protection Program and the data needs for each portion of the Groundwater Protection Program that support these goals are presented below This discussion is followed by a detailed discussion of the groundwater monitoring program which is the primary system used in groundwater protection and management

4 2 2 Protection from Overdevelopment

In general, the rights to groundwater resources in Colorado are unrelated to ownership of the land under which those groundwater resources are located However, for the Denver Basin aquifers, which includes the lower aquifers at the RFP, the right to groundwater resources does derive from land ownership so long as the water is not tributary to any surface water supplies The rationale for this distinction is the fact that the withdrawal of water from these aquifers has little or no effect on surface streams or tributary groundwater and that recharge to the aquifers is minimal, making withdrawal of the water equivalent to the extraction of a mineral Tributary groundwater is that groundwater which contributes to flow in streams Nontributary groundwater is that groundwater which is not tributary groundwater Withdrawal of more than a specified amount of nontributary groundwater underlying a piece of property is prohibited Tributary groundwater may also be developed by landowners, but a water-rights augmentation plan must be developed, approved, and implemented to prevent any injury of senior water rights Given the above considerations, any development of groundwater near the RFP cannot legally affect the groundwater under the RFP boundaries. Nevertheless, should large-scale development of groundwater resources in the area be planned, the RFP personnel will evaluate the immediate and potential impacts such development may have on groundwater at the RFP and take appropriate action

The protection of the RFP groundwater from overdevelopment has been a relatively minor consideration to date The primary data needs for protection of groundwater from overdevelopment are monitoring of groundwater elevations and the results of drawdown/pumping tests throughout the RFP groundwater monitoring network as detailed in the RFP Standard Operating Procedures (SOPs) These data are routinely generated as a part of the Groundwater Monitoring Program for those geologic media monitored.

4 2 3 Protection from New Sources of Contamination

Potential groundwater contamination could be from both known or unknown sources of contamination All known new potential sources of the RFP groundwater contamination will be monitored before, during, and immediately following the implementation of any operations which could potentially impact groundwater quality This monitoring will be planned and executed in order to determine the site-specific ambient groundwater conditions The intent of such monitoring is to immediately detect any release of contamination to groundwater Similarly, the design and implementation of any operation which could potentially impact groundwater will be consistent with the Groundwater Protection Program at the RFP

The occurrence of unknown new sources of the RFP groundwater contamination is expected to be identified by the extensive groundwater monitoring network at the RFP (Plate 1) This extensive monitoring network will help identify contamination from unknown sources Groundwater is routinely sampled as detailed in the SOPs. Resultant data are generated as a part of the Groundwater Monitoring Program for those aquifers from that network monitored Evaluation of these data will identify unknown new sources of contamination by identification of elevated contaminant concentrations near the source of contamination

4 2 4 Identification and Remediation of Existing Contaminated Areas

Known areas of groundwater contamination (as detailed in Section 2 0 of this document) and known areas of potential groundwater contamination (as identified in Section 1.3.1 of this document) are included in this RFP Groundwater Protection Plan for investigation and potential remediation of the contaminated source The purpose of the remedial actions is to prevent the further migration of contamination (thus protecting currently uncontaminated areas) and to cleanup already-contaminated areas Those areas already contaminated or potentially contaminated are included in designated Operable Units (OUs) and are scheduled for investigation and potentially for remediation as detailed in the IAG These areas are protected from further contamination and are monitored for groundwater characteristics in order to identify the extent of existing contamination and the rate of contaminant migration and to develop the data necessary to adequately formulate a plan for appropriate remedial actions The routine generation and analysis of the data generated in these areas will identify data needs When data needs are identified, appropriate action will be implemented to generate these data. Data to support the goal of identification and remediation of existing contaminated areas are routinely generated as detailed in the Groundwater Monitoring Program

4.3 Groundwater Monitoring Program

Groundwater monitoring is an essential function of groundwater protection The overall objective is to identify and protect groundwater resources in the vicinity of the RFP from further or potential damage The goal is to assess the quality and quantity of groundwater resources in the vicinity of the RFP in order to properly manage it

The Groundwater Monitoring Program at the RFP currently consists of 259 wells and piezometers, which are currently sampled regularly The program has been designed to protect the groundwater and to measure the concentration of hazardous constituents and determine the rate of movement, and to define the extent of any contaminant plumes in the uppermost aquifer within the RFP boundaries (Plate 1) The "uppermost aquifer" is described in Section 2 2, Hydrogeology, of this document. Three OUs, (the Solar Evaporation Ponds (OU4), the Present Landfill (OU7), and the West Spray Field (OU11)) at the RFP are subject to Interim Status groundwater monitoring requirements under RCRA The remainder of the RFP OUs are sampled to characterize the groundwater during RFI/RI activities or do not require a specific groundwater monitoring system, but have been included in the RFP Groundwater Monitoring Program to supply hydrogeologic and analytical data needed to characterize other areas of the RFP The water-quality variables for analysis for monitoring wells in OUs are provided in the workplans for the OUs The workplans are approved by the land regulatory agency

The well network undergoes constant evaluation to determine the most effective approach to sampling groundwater at the RFP This evaluation takes into account current regulations and streamlines the program to meet those requirements in the most efficient manner Water-quality variables for analysis have been selected based upon EPA and CDH requirements, technical needs, and the history of operations at the RFP (see Table 2-5)

The existing RCRA groundwater monitoring network in use at the RFP is comprised of both Groundwater Quality Assessment and Alternate Groundwater Monitoring Systems that are establishing compliance with the regulatory requirements of 6 CCR 1007-3, 265 93 (40 CFR 265 93) and 6 CCR 1007-3, 265 90(d) (40 CFR 265 90 (d)), respectively. Included in the RFP groundwater monitoring program are

- A network of background wells;

- A network of monitoring wells,
- A monthly measurement of water elevations,
- A quarterly sampling and analysis program,
- An assessment program,
- A program for reporting information to the appropriate regulatory and community agencies on an annual basis,
- A well abandonment and replacement program,
- An annual evaluation program,
- A protection program, and
- A special projects program, e g , FY 91-92 characterization of groundwater at the Wind Site to establish groundwater quality in accordance with WQCC standards

The groundwater monitoring network at the RFP is comprised the following of five categories of monitoring wells

- RCRA wells - Wells that monitor the shallow, unconfined aquifer and which are used to
    - Immediately detect any statistically significant amounts of hazardous constituents that migrate into the shallow, unconfined aquifer;
    - Determine the rate and extent of migration of hazardous waste constituents in groundwater, and
    - To characterize groundwater for RFI/RI activities.
- CERCLA wells - Wells that are installed to characterize the groundwater for RFI/RI activities
- Boundary wells - The monitoring wells at the RFP boundaries used to determine whether groundwater is leaving the RFP These wells are

located downgradient of the RFP affected activities (i e., specified wells along Indiana Street) (see Plant 1)

- Background wells - Wells that monitor the groundwater in areas upgradient or cogradient of the RFP
- Characterization wells - Wells not included in any of the previous classifications but which are needed to characterize the groundwater (i.e., wells within a RCRA OU that monitor confined hydrostratigraphic units not present by indicating hazardous waste contamination).

Detailed information on well categories and the groundwater monitoring network is in Appendix C

4 3 1 Program Field Activities

Quarterly Sampling and Analysis

Two hundred fifty-nine wells provide the basis of the presently operational groundwater-sampling network (Appendix C) All wells that contain water each quarter are sampled. A quarterly schedule of sampling and analysis of water quality in wells at the RFP has been chosen in order to generate data representative of the various groundwater conditions at the RFP and to ensure compliance with applicable groundwater regulations. For example, RCRA regulations require quarterly groundwater monitoring The frequency of sampling for wells used to characterize groundwater for CERCLA investigations has not been specified All wells are purged and sampled according to procedures detailed in SOP GW 6 (EG&G, 1991f) The samples are analyzed for the Target Analyte List (TAL) for VOCs, radiochemical constituents, and trace metals (Table 2-5) Wells not containing water during any given quarter are measured again for water level the following quarter If water is not detected after eight consecutive quarters, the well would not be considered useful and it would become a candidate for abandonment

A data-collection schedule has been proposed for the quarterly sampling network This will ensure that samples for any particular well are collected as close as possible to quarterly intervals The schedule is used as a guide (except as required by specific regulations), and may be modified as needed to account for unplanned changes that occur during the sampling quarter

EG&G Environmental Restoration SOP GW 6 Groundwater Sampling (EG&G, 1991f) describes the procedures used for the collection of all groundwater samples. Fundamental aspects of these procedures are as follows

- Sampling techniques should not introduce contamination to samples or wells

- All downwell equipment will be made of materials considered to be inert. Techniques for the use of this equipment will ensure a high level of sample integrity and minimize the potential for cross contamination of samples or contamination of any well with foreign materials

- Water elevations will be taken in accordance with SOP GW 1 (EG&G, 1991g).

- Sampled water should represent formation water

- All sampling devices are designed for the collection of representation samples that reflect actual formation conditions Well productivity is equally important when employing techniques for the use of sampling equipment Not all alluvial and bedrock formations at the RFP produce enough water to sustain a constant well water level while purging, some wells dewater during purging Recharge water becomes aerated while cascading along the inner wall of the well casing, which potentially alters the chemistry of the collected water Therefore, specific recharge volumes and sampling times have been established that produce samples most closely representing formation conditions

- All water collected after the purging criteria are met is considered to be homogenous Replicates collected as split samples for regulatory agencies are assumed to be identical to samples collected for EG&G To further ensure the replicate samples are identical, sample containers are filled alternately for the regulatory representative and the EG&G sample crew

- All sampling techniques are standardized to ensure reproducibility of results.

- All field sample crews are trained in the techniques described in the SOPs, and standardized equipment is used during the sampling events This symmetry between sampling crews eliminates sampling variability. Samples collected during any quarter can be compared to previous and subsequent quarters without implications of field inconsistencies

- Anthropogenic contamination at any level should be identified

- Whenever there are limited sample volumes available for collection and the entire analyte list cannot be analyzed, the sample analyses are prioritized in the following manner and per EG&G Environmental Restoration SOP GW 6 Groundwater Sampling (EG&G, 1991f) as follows

    - Hazardous Substance List VOCs
    - Gross alpha and beta
    - Uranium $^{(233, 234, 235 \text{ and } 238)}$
    - Inorganic ions (Chloride fluoride, sulfate, phosphate, and carbonate)
    - Nitrate/Nitrite, as Nitrogen
    - Orthophosphate
    - TAL Metals
    - Plutonium $^{238/239}$
    - Radium $^{(226, 228)}$
    - Strontium $^{89/90}$
    - Cesium ^{37}
    - Tritium
    - Americium ^{241}
    - Cyanide
    - Radiation Screening

- The isolation and sample collection of immiscible phases are primary concerns of the RFP management, and the program sampling procedures to address these concerns are described in SOP GW 6 Groundwater sampling

<u>Quarterly Measurement of Groundwater Elevations</u>

As part of the Groundwater Protection and Monitoring Program Plan, two hundred fifty-nine wells are measured for water level during the first week of each quarter. These data are collected within one week of each other so that the measurements are as temporally related as possible This allows the preparation of the RFP-area wide water-elevation maps that accurately portray conditions for that period. This addresses both a regulatory requirement and a technical need to accurately know groundwater flow directions. For instance, three wells that are downgradient of a given site one quarter may not qualify as downgradient in another quarter Such a situation could require installation of additional wells to determine if contamination is migrating away from the site This task has been designed to produce data that are as synoptic as possible using manual techniques. Between two and five sample crews are mobilized to complete this task within five days. All water levels are measured as described in EG&G Environmental Restoration SOP GW 1, Water Level Measurements in Wells and Piezometers (EG&G, 1991g). In addition, well condition is assessed during this task and the information is used to coordinate subsequent monitoring tasks Data have been collected in this manner since the first quarter of calendar year 1990

Water level measurements collected prior to the first quarter of 1990 did not serve as a specific water-level measurement task Groundwater levels were collected prior to purging during each sampling event but a complete set of water levels was not collected in a given week

Monthly Measurement of Groundwater Elevations

For all months when a quarterly water-level measurement task is not performed, a subset of wells listed in Appendix C are measured for water level These monthly measurements of water level are made in order to better understand both seasonal and year-to-year groundwater elevation fluctuations at the RFP Some wells at the RFP only contain water during certain periods of the year Monthly water-level data for these wells may provide information useful in the evaluation of these fluctuations This addresses both a regulatory requirement and a technical need to know groundwater flow directions and fluctuations This task is performed over five days by one field crew Before being finalized, results from each month's measurements are compared to those taken during the most recent previous water level monitoring Because groundwater sampling is performed concurrently with this task, the process of dewatering wells that recover slowly may affect the representativeness of the monthly water levels. Measurements that may not reflect natural formation conditions are flagged with an appropriate qualifier

Well Maintenance

Well maintenance is an important aspect of in any groundwater monitoring program. Wells must be maintained in order to ensure the usefulness of the well as well as to allow the collection of samples representative of groundwater quality.

Total well depth is recorded quarterly during the initial water-level measurement task. The measured total depth is compared to "as-built" drawings and the amount of accumulated sediment in the well is evaluated over time Wells in which materials smaller than the well screen size has accumulated are scheduled for redevelopment. The principal criterion needed for redevelopment is the accumulation of sediments above the base of the screened casing interval Redevelopment is designed to eliminate excessively turbid samples and therefore to produce better sample quality. In addition, wells with minimal sediment accumulation have more water-storage capacity This is important in all wells that bail dry and require multiple days for sample collection. Redevelopment methods are based on an understanding that low-energy methods are the most appropriate for the aquifers at the RFP that have relative low hydraulic conductivity These methods are described in detail in EG&G SOP GW 2 (EG&G, 1991h)

Additional information concerning the integrity of the well is collected during each quarterly water-level measurement task Well pads that are superficially cracked are scheduled for repair Surface seals that are broken and show evidence that surface runoff may have destroyed well integrity are not repaired Instead, they are considered for abandonment The maintenance of mark points for elevation reference are also verified These are the points at which water-level measurements are referenced and should be easily identifiable in order to ensure accurate water-level measurements. If the mark points do not exist or are difficult to locate, new mark points are etched into the northern edge of the well casing Finally, the annulus between the well casing and the protective structure is cleared of accumulated debris

Well Abandonment and Replacement

In certain cases, it will become clear that the usefulness of some groundwater monitoring wells is exceeded by the potential liability associated with the existence of that well. Such wells should be considered for abandonment/replacement Abandonment of a given well will result in elimination of the well from the monitoring network in such a manner that the well will not remain a conduit for groundwater or contaminant migration Clearly, all possible actions are taken during well installation and subsequent use to minimize the numbers of wells that need abandonment/replacement. However, well abandonment/ replacement is a necessary consideration in any groundwater monitoring program.

A complete review of all wells for viability and program usefulness has been performed per specific recommendations made by the Governor's Rocky Flats Scientific Panel on Monitoring Systems The review results in a list of wells to be considered for abandonment Wells that fail to meet the following criteria are placed on this list

The review of wells for viability in the program includes the following criteria

- All well records must be complete
- Wells must be constructed of materials considered by industry standards to be appropriate for monitoring wells.
- Well completion procedures are adequate to isolate a specific aquifer and to eliminate the potential of cross contamination of other aquifers

- Well completion procedures are adequate to eliminate the flow of surface water into the well along the casing
- Well integrity has not deteriorated over time
- Obstructions are not present that restrict access to the total length of the well.
- The well is capable of yielding enough water to be sampled at least once every 8 quarters

The review of wells for usefulness in the program includes the following criteria:

- The well is integral to the current groundwater monitoring program
- The well is integral to other ongoing RFP programs
- The well is integral to future RFP programs

The well redevelopment task will be used as a quarterly review to assess well degradation Wells that fail the viability and usefulness test at any time will be considered for abandonment In addition, the RFP wells will be reviewed annually for identification of those wells that do not meet the criteria established by the Governor's Panel. These wells will also be considered for abandonment

Special Projects Program

Groundwater resources at the Wind Site facility located in the northwestern buffer zone are being characterized to evaluate if it has been contaminated In 1989, benzene was detected in a tap water sample from the facility The objective of the characterization is to determine if in fact the groundwater at the Wind Site is contaminated. If the water is found to be contaminated, then it will be necessary to identify the groundwater flow rate and direction as well as to identify the source and concentration of contamination.

4 3 2 Standard Operating Procedures (SOPs)

The Environmental Management Division Standard Operating Procedures (SOPs) required to perform the groundwater monitoring tasks have been approved by CDH and EPA Compliance with the requirements set forth in these SOPs should produce data that is representative of groundwater quality, comparable from well to well, and reproducible for any given well These are requirements of a groundwater protection program both regulatorily and technically

4 3 3 Quality Assurance/Quality Control (QA/QC)

Specific QA procedures have been written to enforce compliance with the SOPs and have been included in the Quality Assurance Project Plan (QAPP) which was transmitted to EPA and CDH on June 1991 Certain Quality Control (QC) measures have been incorporated in the SOPs This was done to ensure that data are collected properly and that the measurements are accurate

The Rocky Flats Environmental Data Base System (RFEDS) is an Oracle-based relational database developed by the EG&G Environmental Restoration Department to serve as a controlled source of analytical and field data Data currently managed in RFEDS include radiochemistry, volatile and semi-volatile organic compounds, pesticides, metals, and inorganic parameters for surface water, soils, and sediment monitoring samples. Field parameter data (sample location, sample date, pH, Eh, conductivity, and temperature) are included as well as groundwater level measurements, and chemical information (CAS numbers, physical parameters, detection limits, levels of concern) Each sample parameter in RFEDS contains a field for the validation code and four fields to validate acceptable or rejected data Specific procedures for verification of database information derived from contracted sources or put directly into RFEDS have been developed and are being implemented These procedures provide QA documentation that assures all available data have been incorporated and entered or uploaded properly into RFEDS. Other procedures have been developed for database system security and software change control

All laboratory work is done to Contract Laboratory Program (CLP) standards. The QA/QC for any non-CLP and non-radiochemistry also parallels CLP protocol to include continuous equipment calibrations and method blanks for every 1 in 10 samples. The CLP-type analysis is outlined in Section 2 4 of the General Radiochemistry and Routine Analytical Service Protocol (EG&G, 1990h) Ten percent of all data routinely undergo the validation process

4 3 4 Technical Issues: Aquifers vs Hydrostratigraphic Units

The definition and general understanding of an aquifer is indistinct Freeze and Cherry (1979) define an aquifer as "a saturated permeable geologic unit that can transmit significant quantities of water under ordinary hydraulic gradients." Fetter (1988) defines an aquifer as "rock or sediment in a formation, group of formations, or part of a formation which is saturated and sufficiently permeable to transmit economic quantities of water to wells or springs " A hydrostratigraphic unit has been defined as a portion or group of geologic formations with similar hydrologic characteristics (Fetter, 1988). These units, which include the Rocky Flats Alluvium and the subcropping Arapahoe Formation sandstones, have hydraulic conductivities in the range of 10^{-5} cm/sec which equate these hydrostratigraphic units with a very poor aquifer The confined unweathered hydrostratigraphic units such as Arapahoe Sandstones Nos 3, 4, and 5 have hydraulic conductivities of 10^{-6} cm/sec , which is so low that for practical purposes these sandstones do not qualify as aquifers Hence, only the Rocky Flats Alluvium and the subcropping Arapahoe sandstones that comprise the uppermost hydrostratigraphic unit will be referred to as aquifers, whereas, the Arapahoe Sandstone Nos 3, 4, and 5 will be referred to only as hydrostratigraphic units

4 3 5 Data Analyses

Section 3 0 detailed a number of requirements of the existing Groundwater Protection and Monitoring Program These objectives basically fall into two categories: 1) site characterization and establishment of baseline background chemical concentrations; and 2) monitoring for chemical releases The following paragraphs describe the data analyses planned for meeting these two fundamental objectives

Groundwater chemical analyses are received from the analytical laboratories, undergo data validation, and are entered into the RFEDS database The subsequent analyses of these data includes statistical analysis, hydrogeologic modeling, and inputs to geochemical modeling The statistical analysis will be described here in general terms and modeling efforts are outlined in Section 4 3 6

A similar set of statistical procedures will be used to meet both of the above mentioned fundamental objectives However, in the case of establishing background analyte concentrations, the application of multivariate analysis of variance (MANOVA) and confidence intervals will be used Chemical occurrences and releases will be evaluated through comparison of non-background data to outliers, analysis of variance (ANOVA) procedures, or tests of proportions

The data will initially go through a cleanup phase This data-preparation phase will involve removing data marked as rejected during data validation and testing for outliers. The treatment of outliers requires professional judgment on the part of the geostatistician, because outliers may result from numerous causes Some outliers may be the result of outright errors in transcription or the incorrect reading of an analytical instrument They also may be real observations drawn from a skewed distribution or they may indicate the presence of unexpected contamination Attempts will be made to explain noted outliers and to correct those that are the result of recoverable errors However, some outliers may be excluded from further analysis so as not to bias the computation of statistics such as the mean and standard deviation Any outliers removed from the dataset will be discussed in the report resulting from the analysis. The handling of outliers in the database and statistical methods used must follow those approved by EPA (Rockwell International, 1989a and EG&G, 1990b)

The proportion of non-detects is examined, and the non-detects are replaced with a value of half the detection limit for statistical computational purposes Also, normal and lognormal probability plots will be used to examine the data distributions.

Background populations will be determined through MANOVA (or ANOVA) analysis using Statistical Analysis System (SAS) or equivalent statistical software. The basic ideas underlying analysis-of-variance techniques are to separate and identify the sources of the variance observed in a set of data and to test the hypothesis that a number of populations (represented by samples) are statistically identical

After the background populations have been selected using ANOVA techniques, background tolerance intervals will be computed The confidence intervals are expected to be the principal means of identifying chemical anomalies which may indicate anthropogenic chemical contamination ANOVA or a test of proportions may also be used to compare downgradient wells with background wells to determine chemical occurrences when confidence intervals are not available

After sufficient data have been collected, the dataset will be examined for any noted effects of seasonal variability The rationale for studying seasonal variability is that seasonal changes in analyte concentrations may result in a false reading that exceeds an upper tolerance limit

4 3 6 Modeling

Computer modeling of groundwater flow and groundwater contaminant transport at the RFP is a necessary tool for characterizing the groundwater flow regime and determining the fate of contaminants introduced to the groundwater system. The value of the modeling approach is its ability to integrate site specific data with equations describing the relevant physical and chemical processes to predict changes in groundwater flow and quality In addition to furthering our understanding of the hydrogeologic system, modeling directly supports (1) remedial action design by evaluating the effectiveness of methods for containing and treating groundwater, (2) risk assessment through estimation of contaminant concentrations at potential receptor locations, and (3) the design of monitoring networks by estimating the extent and configuration of the contaminant plume.

Purpose

Groundwater flow and contaminant transport modeling is being implemented at the RFP to meet the following objectives

1) Integrate geologic and hydrogeologic characterization data into a conceptual model of site-wide groundwater flow This process is inherently iterative and provides a basis for an evaluation of the site-wide characterization program In addition, the site-wide model will provide estimates of (a) the seasonal groundwater pressure distribution, (b) groundwater travel times from areas of known contamination to specific discharge points or other areas of concern, and (c) transient boundary conditions that can be applied to smaller scale models

2) Predict the movement of contaminant plumes and evaluate the potential for contaminant migration along exposure pathways Contaminant transport modeling is necessary to estimate the rate and extent of contaminant migration and concentration at biological receptor points Modeling will directly support human health risk assessment

3) Evaluate the effectiveness of remedial actions Groundwater flow and contaminant transport modeling will be implemented during the feasibility

and design phases of remedial actions that remove, contain, or otherwise prevent the dispersal of contaminants

4) Assist in the design of the groundwater monitoring network. Calculation of the rate and extent of contaminant plume movement will assist in optimizing the spatial and temporal sampling densities of the monitoring network.

Modeling applications and evaluations will be conducted at various scales at the RFP. The largest scale will involve a regional/site-wide model including recharge areas west of the RFP (between Highway 93 and the foothills), discharge areas (such as seeps), Great Western Reservoir, and Standley Lake The purpose of this model is to evaluate the potential regional impact from the RFP and to provide transient groundwater boundary conditions to specific OU models Other applications at smaller scales such as the 881 Hillside, the 903 Pad, Mound, and East Trenches, and the Solar Evaporation Ponds will focus on local contaminant sources and discharge points

Groundwater flow will be modeled within those geologic units discussed in Section 2.1 The Rocky Flats Alluvium, colluvium, valley fill, weathered claystones, and subcropping sandstones of the Arapahoe Formation and Laramie Formation are of primary concern. Sandstones confined by lower permeability competent and weathered claystones will also be evaluated for potential hydraulic connectivity with overlying contaminated units through the modeling and field characterization program The number of specific units modeled will vary as a function of the model scale and purpose

A significant area of the surficial material at the RFP, though perhaps not a significant volume, is unsaturated during the dry summer and fall quarters It is necessary to evaluate the need for unsaturated flow monitoring and modeling to evaluate transport in the vadose zone The potential for vadose zone flow will be evaluated specifically for hillslope areas such as the 881 Hillside and Solar Evaporation Ponds where the potential for vadose-zone contaminant transport exists

Data Requirements

Hydraulic properties of the hydrologic units derived from characterization investigations will be utilized in the modeling process In addition, hydraulic conductivity data, specific storage, and specific yield data will be available from four multiple well aquifer tests scheduled for completion in 1991 Longitudinal dispersivities will be available from several in situ dispersivity tests scheduled for completion in 1992. The hydraulic conductivity and effective porosity values will be available from an ongoing laboratory analyses program

Hydrologic unit geometry and boundary conditions are available from the current hydrogeologic characterization and mapping program. A subset of the quarterly water level measurements discussed in Section 4 3 are measured within one week to provide a single point-in-time representation of groundwater levels that will support model calibration In addition, these data allow calculation of saturated thicknesses and delineation of unsaturated alluvial areas Natural stresses on the hydrologic system such as recharge from infiltration and discharge at seeps, streams, and from evapotranspiration are currently being characterized

Measurement of unsaturated hydraulic conductivity and development of moisture retention curves are part of a vadose zone characterization program scheduled for implementation in 1991 This program will make use of in situ field measurement equipment (i.e. tensiometers) and laboratory testing of core materials in areas where unsaturated zone characterization is necessary

Geochemical Modeling

Geochemical modeling applications (as described below) will be performed using the RFP groundwater and bore hole geochemical data. Geochemical modeling is useful for interpreting and quantifying the effects and relative importance of adsorption, ion speciation, reduction/oxidation environment, ionic strength, temperature, and the solubilities of solid phases on the concentrations of aqueous constituents in groundwater. This modeling will be used to understand interactions between the groundwater chemistry and authigenic phases which may be present in the porous medium (hydrostratigraphic unit) Modeling is also useful for explaining any systematic evolution of groundwater chemistry from recharge to discharge points

In recent years, geochemical modeling has increasingly overlapped with hydrological modeling in the areas of chemical fate and transport A growing number of hybrid (hydrogeochemical) models combine hydrological processes, evaluating processes, such as the advection and dispersion of solutes, with the simulation of one or more geochemical processes, such as adsorption or the degradation of organic chemicals through hydrolysis

Both classical and hybrid geochemical models have unique advantages and will be used to model groundwater resources underlying the RFP Geochemical models excel in their ability to model a wide spectrum of water chemistry processes and inorganic chemical systems Some of the hybrid models tend to be limited in their depth of modeling chemical processes, but they excel at addressing the transport and attenuation of organic compounds moving through an aquifer Hybrid models that may be used on the RFP groundwater are SUTRA, RANDOM WALK, ODAST, and MOC Classical geochemical models to be employed at the RFP may include PHREEQE, MINTEQA1, and EQ3/6 The advantages of each of these models are discussed below

PHREEQE is a commonly used model developed by the U S Geological Survey (USGS) that is easy to use and relatively versatile It performs equilibrium aqueous speciation calculations and determines the state of saturation of a natural water with respect to precipitation or dissolution of mineral phases PHREEQE can also perform mass transfer calculations, following one or more phase boundaries and calculate pH and Eh as dependent variables The program can simulate the reaction of water with a solid phase the effect of mixing of two different waters or the titration of one water by a second one

MINTEQA1 is a widely employed equilibrium metal speciation model supported by the EPA Like PHREEQE, it is able to model a range of water chemistry problems, but it is more flexible in its ability to model sorption Six sorption models are built into the code. The choice of sorption model is largely dependent on the availability of sorption data.

EQ3/6 is a complex family of codes developed at Lawrence Livermore Laboratory. The EQ3/6 package consists of two main modeling codes, EQ3NR and EQ6, as well as support programs such as MCRT EQ3NR is the basic equilibrium speciation model, while EQ6 provides sophisticated mass transfer modeling, including kinetics. EQ6, for example, can follow the chemical evolution of a packet of groundwater as it moves downgradient These codes make use of the EQLIB software library and have a very extensive data base that can be used to model typical groundwaters and those at high water temperatures or with high salinities

The amount and usefulness of geochemical modeling is obviously limited by the quantity and quality of the data In general, a geochemical model should have data for all major dissolved constituents in groundwater, along with the trace elements of interest. Reliable field-measured pH values can be critical to this type of modeling Geochemical models are much less sensitive to parameters like water temperature

Knowledge of the oxidation-reduction (redox) state of the water is important for those chemical systems with multiple oxidation states such as the iron, sulfur, chromium, and uranium system Unfortunately, the redox state of a natural water is not easy to quantify. In fact, most groundwater is probably not in redox equilibrium The concentrations, or simply the presence or absence of redox-sensitive species like dissolved oxygen and hydrogen sulfide, can often be used to estimate the redox state of the water for modeling purposes

In addition to water chemistry data, it is desirable to have information regarding the clay mineralogy and the framework mineralogy of the hydrostratigraphic units. Especially important is the presence or absence of authigenic solid phases and organic matter. Authigenic phases tend to be closer to equilibrium with the prevailing water chemistry and may be important in modeling adsorption and precipitation They also may provide an indication of the prevailing redox environment The content of organic matter can be important in estimating the effects of adsorption as well as the redox environment. The effects of sorption will probably be modeled using partition coefficients because it is the simplest approach with the most data available

Model Application

Groundwater flow and contaminant transport modeling at the RFP will consist of several components As discussed previously, a site groundwater model is necessary to provide hydrologic boundary conditions for smaller scale models and to evaluate site-wide flow Analysis of available data for sitewide and regional scale modeling is underway Models currently under consideration for regional and sitewide scale modeling include MODFLOW (USGS), SWIFT (GeoTrans), SUTRA (USGS), and TARGET (Dames and Moore).

Site-wide model development will incorporate sensitivity analysis to determine model parameters or boundary conditions that are responsible for a significant change in model response (i e , change in the groundwater head distribution) Such an analysis is necessary to assist in evaluating the environmental monitoring network and determining areas of the plant and surrounding areas that may require further geologic characterization Unsaturated flow and transport codes under consideration include

VADOSE (Analytic and Computational Research, Inc), SUTRA (USGS), and SWANFLOW (GeoTrans), and TARGET (Dames and Moore)

Models applied to specific OUs will be selected according to the following criteria:

1) The selected models must be able to adequately simulate site conditions.

2) The complexity of the model must satisfy the study objectives and available data

3) The selected models must be verified and reasonably well field tested.

4) The selected models must be documented, peer reviewed, and available. Preference will be given to models that supply original source code and are in the public domain

Models under consideration for modeling groundwater conditions at the RFP OU5 include but are not limited to, MOC (USGS), SWANFLOW (GeoTrans), SWIFT (Sandia National Laboratory), GASOLINE (USGS), TARGET (Dames and Moore) and MT3D (Papadopulos) These codes vary in their dimensionality, type (finite element, finite difference), and in the physical and chemical parameters modeled

4 4 Groundwater Protection From Future Contamination

The best method to protect the groundwater at the RFP is to eliminate potential for contamination before it occurs Currently, proposed RFP monitoring and review activities are being evaluated to ensure integrity of the groundwater system A review team has been established to review all inventory and resumption procedures for environmental concerns All construction activities (including those in the Protected Area) are scrutinized to ensure that groundwater will not be compromised

If the groundwater is contaminated or suspected of becoming contaminated, then an active, well-designed monitoring program protects that groundwater resource that has not been contaminated By monitoring the concentrations, rate of movement, and extent of the contaminant plumes, it is possible to initiate remedial actions that will protect the clean groundwater

A recent RFP example of groundwater protection occurred in response to the proposed landfill area During the siting study, monitoring wells were installed to evaluate groundwater constituents and concentrations The proposed locations of the landfill were predicated on the need for low water-table levels to limit potential groundwater contamination by contact with the future landfill

In addition, a continual evaluation of the monitoring wells is needed to protect areas that are classified as uncontaminated The Well Abandonment and Replacement Program is designed to remove wells from the groundwater monitoring program that are damaged or suspected of having cross flows that could contaminate clean intervals As stated previously, all of the pre-1986 wells are scheduled to be abandoned beginning in FY 92, because the construction for most of these wells is not known and there is a potential for cross contamination in lower bedrock intervals

4.5 Groundwater Remediation Program

The specifics of the groundwater remediation program at the RFP will be largely defined in the future The reasc ı for this delay is that the majority of sites at the RFP are not yet adequately characterized to formulate the appropriate remedial actions. However, the process of selecting which remedial alternatives are most suitable for a given site are identified in the IAG The IAG defines the general process of site remediation, including groundwater remediation, for any site at the RFP requiring it These general requirements comply with all RCRC, CERCLA, and CHWA requirements. The cleanup process described in the IAG requires a thorough investigation of a given OU in order to assess the nature and extent of contamination at the facility. The results of these site-characterization activities are published in the RCRA RFI/RI report An evaluation of the suitable remedial action alternatives must then be performed This evaluation initially considers many possible methods for remediation but narrows the possible alternatives down to those that are most effective, long-lasting, and cost effective A preferred remedial action is eventually selected This evaluation and its conclusions are published in the Corrective Measures Study/Feasibility Study (CMS/FS) The CMS/FS is made available to the public during a 60-day comment period during which a public hearing will also be held DOE then has to respond to all public comments in a Responsiveness Summary If the Responsiveness Summary is adequate, it becomes part of the Administrative Record, and the remedial action for the OU is selected taking into consideration the public comments received Next, the Corrective Action Decision (CAD)/Record of Decision (ROD) is prepared. This documents the decision making regarding final remediation A detailed plan for implementing the remedial action is then submitted and remedial action can proceed In addition to the above, an Interim Measure or Interim Remedial Action (IM/IRA) can be performed at any time if site conditions warrant this action IM/IRAs are implemented as short term responses to immediate threats to human health and the environment due to the extensive time it typically takes to determine final remedial actions The IM/IRA occurs before and must be consistent with final remedial actions at the OU Final remedial actions ensure a more permanent and broad solution to the environmental contamination identified

At present, three IM/IRAs in OUs 1, 2, and 4 are underway or planned at the RFP Only one of these IM/IRAs directly addresses remediation of contaminated groundwater. The IM/IRA for OU1 includes construction of both a French drain system to intercept contaminated groundwater and a holding and treatment system for this contaminated groundwater This type of IM/IRA is typical of the IM/IRAs and final remedial actions that may be used at the RFP to address contaminated groundwater The IM/IRA documents for OU2 surface seeps address the issue of whether the water flowing at these surface seeps should be separately collected for treatment This IM/IRA is currently being reviewed and discussed with the regulatory personnel. The IM/IRA documents for groundwater collected and stored OU4 also addresses the issue of treatment of these waters (collection of the groundwater is not addressed in the IM/IRA document). This IM/IRA is also under review by the regulatory personnel

ROCKY FLATS PLANT GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN	**Manual No.:**	**21000-MP-GPMP**
	Procedure No.:	**5.0, Rev 0**
	Effective Date:	**2/15/92**
	Organization:	**Environmental Management**

Evaluation of Existing Groundwater Protection and Monitoring Program

Approved by:

J. W. Langman Jr. 2/18/92

Project Manager **Date**

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This is a RED STAMP

Reviewed for Classification /UCNI

By. George H. Setlock

Date 11/21/91 UNU

5.0 EVALUATION OF EXISTING GROUNDWATER PROTECTION AND MONITORING PROGRAM

This section of the report presents a comparison of the existing groundwater monitoring program at the RFP (Section 4 0) with the requirements of the groundwater monitoring program as identified in Section 3 0 of this report. Areas of deficiency are identified and are addressed in Section 6 0 of this report

5.1 Compliance Posture

5 1 1 Regulations

For the purposes of this section of the report, the "regulations" are considered to include the DOE Orders as well as the environmental regulations enforceable by CDH or EPA.

The Groundwater Protection and Monitoring Program presented in Section 4 0 of this report has been evaluated and every effort is being made to ensure it is in compliance with the regulatory requirements discussed in Section 3 0 of this report The existing groundwater monitoring program either has activities in progress to comply with or address the following requirements

- Protecting groundwater resources from contamination (required by the DOE Orders),
- Characterizing and assessing the geologic units at the RFP and their impact on groundwater flow and direction (required by the RCRA Interim Status regulations),
- Determining the direction and velocity of groundwater flow (required by the RCRA Interim Status regulations),
- Determining upgradient conditions of groundwater quality;

- Determining baseline, or "background," conditions of groundwater quality and quantity (required by the DOE Orders, and partially by the RCRA Interim Status regulations),

- Ensuring the early detection of groundwater pollution or contamination (required by the DOE Orders and the RCRA Interim Status groundwater monitoring requirements),

- Identifying presence, nature, and extent of plumes at the RFP (required by the DOE Orders and the RCRA Interim Status regulations);

- Determining, on a quarterly basis, the rate and extent of contaminant migration (required by the RCRA Interim Status alternate and assessment monitoring programs),

- Determining, on a quarterly basis, the concentration of hazardous waste or hazardous waste constituents in groundwater (required by the RCRA Interim Status assessment and alternate monitoring programs);

- Providing quarterly analysis of the data (required by the RCRA Interim Status assessment and alternate monitoring programs),

- Providing annual reporting of the data (required by the RCRA Interim Status regulations),

- Assessing the interconnectedness of various water-bearing media (required by the RCRA Interim Status regulations);

- Generating data needed for site characterization and remediation (required by DOE Orders and the CERCLA regulations), and

- Generating data needed for the NEPA compliance activities at the RFP

5 1 2 Agreements

The FFCA, AIP, and IAG, and their impacts on the groundwater monitoring program were discussed in Section 3 0 of this report The existing groundwater monitoring program has the following activities in progress or completed to comply with the requirements stipulated in the agreements

- Preparation and submittal for regulatory review a plan for investigation of groundwater contamination at the STP sludge-drying beds (required by the FFCA),
- Preparation and implementation of a plan for NPDES-related activities dealing with unplanned contaminant releases (required by the FFCA),
- Incorporation of recommended improvements to the groundwater monitoring program based upon CDH comments (required by the AIP), and
- Compliance with RCRA and CERCLA regulations (required by the IAG).

5 1 3 External Requirements

Independent from State and Federal agreements, the RFP has agreed to follow recommendations set forth by the Governor's Rocky Flats Scientific Panel on Monitoring Systems and the Rocky Flats Environmental Monitoring Council Already incorporated into the groundwater monitoring program for the RFP are the following suggestions:

- Computerize data collection and analysis (suggested by the Governor's Rocky Flats Scientific Panel on Monitoring Systems).
- Improve QA/QC for the program (suggested by the Governor's Rocky Flats Scientific Panel on Monitoring Systems)
- Implement additional background analyses (suggested by the Governor's Rocky Flats Scientific Panel on Monitoring Systems).
- Delete wells with incomplete documentation from the program (suggested by the Governor's Rocky Flats Scientific Panel on Monitoring Systems).
- Sample the nearest downstream domestic water well for plutonium (suggested by the Governor's Rocky Flats Scientific Panel on Monitoring Systems)
- Communicate with the public about the RFP issues (suggested by the Rocky Flats Environmental Monitoring Council).

5 1 4 Reporting

Every effort is being made to ensure the RFP groundwater monitoring program is in compliance with applicable reporting requirements The groundwater monitoring program at the RFP collects a tremendous amount of data each quarter, including physical parameters and chemical analyses that are entered into the Rocky Flats Environmental Database System (RFEDS)

Selected data are analyzed and presented in various documents throughout the year. The required regulatory documents are specified in the IAG and include the Annual RCRA Groundwater Report, Annual Background Geochemical Report, and remedial activity reports for the CERCLA OUs In addition to the above reports, a summary discussion of the groundwater program and data is presented in the Annual Environmental Monitoring Report for the RFP

ROCKY FLATS PLANT GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN	Manual No. Procedure No. Effective Date: Organization	21000-MP-GPMP 6.0, Rev 0 2/15/92 Environmental Management

Groundwater Protection and Monitoring Program Improvements Plan

Approved by:

J. W. Langman — Project Manager

2/18/92 — Date

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By George H. Setlock

Date. 11/21/91 UNU

6.0 GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN IMPROVEMENTS

As stated in Section 5 0 of this report, the groundwater monitoring program at the RFP is establishing compliance with the requirements of the various DOE Orders and Federal and State regulatory requirements Consequently, relatively few groundwater monitoring program improvements are required The improvements that are required are all considered to be self-improvements

6.1 Self-Improvements

Data Tracking and Entry

Currently, procedures are being developed to effectively track data from point of origination (field sample collection) through entry into the computerized RFEDS Presently, the time lag between sample collection until availability of analytical results through RFEDS may be as much as six months The turnaround time needs to be reduced to a maximum of 90 days Laboratory contracts require that all non-radionuclide data be provided within 45 days and all radionuclide data within 60 days. The laboratories, however, are currently not meeting these deadlines because they are overwhelmed by the numbers of samples from the RFP Despite the current laboratory restraints, 90 days is considered to be a reasonable length of time for data assessment and incorporation into the quarterly report

Streamlining of Quarterly Analyses and Reports

The required documentation for the quarterly groundwater analysis report needs to be identified and a common set of documenting and reporting guidelines established. Streamlining of the report format and document preparation will aid in timely completion of the data evaluation for identifying and addressing possible groundwater concerns.

Routine Updating of Geology and Hydrogeology

As discussed previously, groundwater data are collected and analyzed quarterly As long as all observed changes are consistent with the accepted geology and hydrogeology of the site, an update of the interpretation of the geology and hydrogeology probably is not required However, when the groundwater data reflect unanticipated changes in some variable, the conceptual models must be modified to account for these changes. These updates are necessary to ensure that the groundwater monitoring program adequately characterizes the rate and extent of contaminant concentrations and is in compliance with all requirements Additional monitoring wells or other investigations may be necessary to adequately characterize observed changes

Similarly, the interpretation of the geology and hydrogeology of the site should be reviewed and updated as necessary new data become available from drilling activities. Again, 90 days is considered the maximum allowable delay from data generation to initiation of updating the geologic and hydrogeologic characterizations of the site

Eliminating Duplicate Data

An additional improvement is to conduct an analytical evaluation of data sources in order to minimize the chance of redundant data collection Monitoring of wells in close proximity such that they are monitoring the same groundwater locale hydrologically and produce no additional information, may be discontinued to avoid duplication No well will be eliminated without lead regulatory agency approval of a change in a OU workplan. A shortened analyte list can be established to monitor known contaminants to avoid sampling for insignificant constituents at specific locales An orderly, well-planned groundwater monitoring well network will result, which will enhance cost effectiveness and data collection efficiency

Self Audits

As regulatory requirements for a program change, or a program enters different phases, it is easy for the program to fall out of compliance with the regulations or its original intent Consequently, a self audit of the groundwater program should be held annually. The self audit would include inspecting the groundwater monitoring system for compliance to all regulatory requirements, proposed requirements, and guidance applicable to groundwater monitoring Following this study, a detailed inspection and tour of all groundwater monitoring activities looking for possible compliance issues or program improvements should occur The findings would then be evaluated to determine whether or not a need exists to implement changes and/or improvements to the existing program.

6.2 Nuclear Quality Assurance

The ANSI/ASME NQA-1 for Quality Assurance Program for Nuclear Facilities is the outgrowth of the American National Standards Institute (ANSI) assigning to the American Society of Mechanical Engineers (ASME) in 1975 the responsibility for the coordination, development, and maintenance of the nuclear standards The ASME Committee on Nuclear Quality Assurance first prepared ANSI/ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Power Plants" for use in the nuclear power industry. The Introduction, Basic Requirements, and Supplements of the ANSI/ASME NQA -1 report together are intended to meet and clarify the criteria of Appendix B of 10 CFR 50, Quality Assurance Criteria, for Nuclear Power Plants and Fuel Reprocessing Plants.

The purpose of the Program is to set forth requirements for the establishment and execution of quality assurance programs for the siting, design, construction, operation, and decommissioning of nuclear facilities. The requirements of the Standard apply to activities which could affect the quality of structures, systems, and components of nuclear facilities DOE Order 5700 6B states that in the nuclear area, ANSI/ASME NQA-1 is the preferred standard for quality assurance

The DOE Rocky Flats Office has endorsed the use of NQA-1 through the Quality Assurance Requirements for Rocky Flats Management and Operations Manual dated February, 1990 This document endorses NQA-1 and identifies the specific requirements of NQA-1 that will be implemented at the RFP

A Quality Assurance Program Description (QAPD) is under development that will govern all activities under the purview of the EG&G Environmental Management Department. This QAPD will include controls for the Groundwater Management Program These controls will require the use of written approved procedures to control all activities governing the sample planning, sample collection, chain of custody, analysis, data verification, and validation The series of procedures will include both administrative and technical procedures The procedures will include provisions for documenting all activities affection quality Specific administrative procedures will provide for a formal records management program to ensure appropriate retention, access, and general control of the documentation These procedures are as follow

- Procedure Development Procedure
- Procurement Document Control Procedure
- QAA/QSS Development Procedure
- Control of Nonconforming Items Procedure
- Personnel Qualification Procedure
- Readiness Review Procedure
- Audits Procedure
- Document Control Procedure
- Surveillance and Management Review Procedure
- Control of Correction Actions Personnel Procedure
- Records Management Procedure

- Qualification of Audit Personnel Procedure
- Control of Purchased Items and Test Equipment Procedure
- Control of Measuring and Test Equipment Procedure
- Risk Assessment Procedure
- Indoctrination and Training Procedure

ROCKY FLATS PLANT GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN	Manual No.. Procedure No.. Effective Date: Organization	21000-MP-GPMP 7.0, Rev 0 2/15/92 Environmental Management

Decontamination and Decommissioning

Approved by·

J. W. Langman 2/18/92

Project Manager Date

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By George H. Setlock

Date. 11/21/91 UNU

7.0 DECONTAMINATION AND DECOMMISSIONING

The closing of the RFP is not anticipated prior to the year 2010 Plans for the decontamination and decommissioning of current RFP operations will be developed at the appropriate time Current decontamination and decommissioning plans for active IHSS's have been detailed in the RCRA Part B Permit for the RFP Remediation of inactive IHSSs is addressed in the IAG

Clean-up levels for contaminated groundwater will be based upon ARARs. Clean-up levels for soils will take into consideration the concentration of contaminants that present a risk of less than 10^{-6}, based upon a risk assessment for exposure to the contaminated soils Contaminated groundwater present under a building may be remediated based upon an analysis of the associated risk

Remedial actions to address contamination identified under buildings will be determined through negotiations with the agencies in authority and through the CERCLA process It is currently anticipated that all contamination will be completely removed or remediated as a portion of decontamination and decommissioning the RFP If this closure performance standard cannot be achieved, hazardous or radioactive contamination that remains in place at the RFP after the RFP closure will be monitored for a period of no less than 30 years Should any change be identified in that period that would increase risk associated with the contaminated area or land use, appropriate action would be taken

ROCKY FLATS PLANT	Manual No		21000-MP-GPMP
GROUNDWATER PROTECTION	Procedure No.:		8 0, Rev 0
AND MONITORING PROGRAM PLAN	Effective Date.		2/15/92
	Organization:		Environmental Management

Implementation

Approved by.

J. W. Langman 2/18/92

Project Manager Date

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Date 11/21/91 UNU

8.0 IMPLEMENTATION

The groundwater monitoring program, as described in previous sections of this document, is currently funded to meet its overall objectives Some areas of need that would allow the program to operate more smoothly and efficiently are noted in the following sections.

8.1 Activity Data Sheets/Schedules

The annual Activity Data Sheets (ADSs) (Table 8-1) have been incorporated in the ADS System for the DOE Five-Year Plan (FYP) (Table 8-2) These ADSs detail budgets and schedules for environmental and base program activities Groundwater monitoring activities and reporting, as well as the well abandonment program, are funded under Base Program ADS No 5023 (Groundwater Monitoring Program) The schedule for these activities are

Well Abandonment and Replacement	10/91 - 10/92
Groundwater Collection and Analysis	10/91 - 10/97
Report Generation	10/91 - 10/97

Other site-wide activities that affect the groundwater monitoring program are funded through other ADSs (i e , site-wide background characterization)

8.2 Funding/Budgeting

8 2 1 Capital

Capital funding will not be applicable to this program because the need for it is not anticipated The cost of all groundwater monitoring activity needs should be easily

Table 8-1

Annual Activity Data Sheet

Groundwater Protection Monitoring Program

1 FYP DATA SHEET # 5023

2 B&R CODES GB 03

3 RFP BS 84014

4 DJO # 986617

5 REGULATORY DRIVERS

RCRA, CERCLA Governor's Scientific Action Plan, Tiger Team Findings

6 TASK MANAGER W Busby/J Langman

7 FY92 MILESTONES

Well Abandonment & Replacement	10/91-10/92
Groundwater Collection and Analysis	Ongoing
Report Generation	Ongoing

8 TASK DESCRIPTION

Activities covered under this ADS include enhanced efforts to monitor contaminants in groundwater and to characterize the hydrologic regime at the RFP

FY92 FUNDING BASIS (000's Except FTE's)	REQUIRED
FTE's	5
Direct Expense $	
Groundwater Collection	2789
Groundwater Analysis	3731
Well Abandonment	1088
Assessment and Report Generation	571
Wind Site Investigation	140
Stable Isotope	148
Hearings & Standards	63
Escorts	73
Total	8603

TABLE 8-2

Rocky Flats Office
Environmental Restoration & Waste Management Five- Year Plan
Activity Data Sheet

ADM OPS OFFICE ROCKY FLATS OFFICE DOE CONTACT F LOCKHART

PHONE NO FTS 320-7846
INSTALLATION Rocky Flats Plant AREA/SITE J PEPE
RELATED DATA SHEET NUMBER 5023
TITLE GROUNDWATER MONITORING PROGRAM
MEDIA WATER RELEASES

FUNDING SUMMARY FISCAL YEAR BUDGET AUTHORITY (IN THOUSANDS OF DOLLARS)

FUNDING BUDGET	1992 REQ	1993* REQ	1994* REQ	1995* REQ	1996* REQ
WELL ABANDONMENT Operating Direct	1088	1197	1316	1316	1316
GROUNDWATER COLLECTION Operating Direct	2789	5144	5273	5273	5273
GROUNDWATER ANALYSIS Operating Direct	3731	7056	7056	7056	10333
ASSESSMENT AND REPORT GENERATION	571	628	691	691	691
WIND SITE INVESTIGATION	140	N/A	N/A	N/A	N/A
STABLE ISOTOPE	148	N/A	N/A	N/A	N/A
HEARINGS & STANDARDS	63	69	76	76	76
ESCORTS	73	80	88	88	88
TOTAL	8603	14000	14500	14500	14500

* Includes wells that will be transferred to Plant and Support after one year of sampling as RFI/RI characterization wells

met from operating costs for the RFP Capital funding requests are made to DOE, which in turn must receive approval of the requests from the U S Congress

8 2 2 Non-Capital Funding

Budgetary accounting for this program will be performed in an expense manner against direct operating costs

8 2 3 Method to Request Funding

The method to request funding for this program begins with a submittal of the anticipated budget by the RFP to DOE during the budget call prior to the beginning of the new fiscal year (FY) The request for direct operating funds is sent to the Program Planning Department for necessary adjustments that depend on the actual available monies, as determined by Resource Management All monies are allocated to the RFP by DOE, who assesses the necessary environmental activities that are to be funded at the RFP DOE is allocated funding for the RFP and other DOE facilities by the U S Congress

8 2 4 Currently Anticipated Funding

The required funding basis during FY 92 for the Groundwater Protection and Monitoring Program incorporates three milestones Well Abandonment and Replacement, Groundwater Collection and Analysis, and Report Generation The ADS for Groundwater Monitoring Program provides labor and expense breakdowns.

8 2 5 Five-Year Plan

The Five-Year Plan for the RFP is a separate document The reader is referred to Rocky Flats Plant FY 93 - FY 97 Five Year Plan (EG&G, 1991j) The plan encompasses waste management operations, inactive waste site cleanup, and corrective actions needed at all DOE operating facilities that carry out programs for Defense Programs, Nuclear Energy, and Energy Research The emphasis of the plan is to coordinate and consolidate DOE waste and cleanup activities and provide a focus for DOE management in this area The Five-Year Plan satisfies the Long Range Environmental Protection Plan required by DOE Order 5400 1

8 2 6 Newly Identified Concerns

The proposed Federal budget cuts could negatively impact environmental programs at the RFP The U S Congress could conceivably reduce the DOE budget proposal in an attempt to lower the Federal budget deficit for FY 92 and future years Another concern is the impact that budget cuts may have on current binding agreements. These impacts could be in the form of assessed fines and penalties for non-compliance, possible criminal indictments of the facility or DOE personnel, and the negative public response to reduction in clean-up programs A DOE budget cutback would cause reductions in the program scopes of work and in certain instances could cause the cancellation of programs The Gramm-Rudman Amendment is an overriding concern because it mandates across-the-board cutbacks to all Federal programs

Should new needs be identified for groundwater monitoring as a result of the routine data analyses, the request for funding would be made as described in Section 8 2.3 of this report This funding request must compete with other funding requests for available money In the case of inadequate funds to support all reasonable requests, upper management of EG&G determines which requests to fund

8 2 7 Shortfalls, Anticipated Problems

The turnaround time for receiving analytical data back from the laboratories continues to create delays in interpretation and has affected the number of quarters of data that can be included in the Annual RCRA Report

The FY 92 budget for groundwater monitoring appears just sufficient to meet all needs. However, should any of the groundwater monitoring budget for FY 92 be reduced, such as due to Federal budget cuts, the groundwater monitoring program would suffer in its ability to achieve some of its many requirements and goals If this were to happen, cuts in the program would have to be made to allow the greatest compliance with the DOE orders and regulatory requirements For instance, one area of potential savings would be to measure water levels in wells only quarterly rather than monthly In this case valuable data that could help characterize the site would be lost but the RFP would not be in violation of any DOE Order or regulation

8.3 Needs (Non-Monetary)

Inadequate field equipment and number of staff are ongoing problems One vehicle is currently available for use by EG&G/EM staff and is insufficient for the number of personnel Additional vehicles are presently required to adequately monitor the field activities

On-site laboratories solely dedicated to groundwater sample analyses for the RFP may effectively diminish the long delay in turnaround time for receiving analytical data from the subcontracted laboratories The RFP labs would enable staff to evaluate the groundwater data before being relayed to the EPA and the CDH.

8.4 Community Interaction

To date, with the exception of the Annual RCRA Groundwater Monitoring Report and the Annual Environmental Monitoring Report, the public has not been routinely informed of groundwater monitoring activities Groundwater monitoring data have been reported to the public when remediation-related reports have been completed or when public comment on a proposed plan or activity is solicited Presentations of groundwater monitoring activities have been made to public groups, such as the Rocky Flats Environmental Monitoring Council, however, these contacts are not made on a routine basis Groundwater data are not discussed at the monthly Environmental Information Exchange Meetings The Draft Final of this document was submitted for public comment. The 60-day public comment period began June 20, 1991 (Figure 8.1). A technical meeting was held for discussion of this plan on July 11, 1991 Comments received from the public have been addressed and incorporated into this final document A complete list of specific comments received and their resolutions is included in Appendix E.

An important part of the groundwater protection monitoring program is keeping the community informed of new information Concentrations of various constituents may be potentially controversial in the public mind if there is a perception of risk to the community The key to the successful management of a project with potentially controversial environmental elements is recognition that no matter how well the technical aspects of the monitoring program are executed and how low the risks are, public perception may be very different This public perception could place the RFP in a position of performing reactionary community relations which may result in project delays and can divert valuable time and energy solving non-problems By setting up a program that pro-actively involves and informs the community, the RFP can improve its relationship with the community and allow technical staff to focus on their work. Controversy is not wholly avoidable, and, when controversy does arise, the issues should be focused on the facts Even when honest efforts are being made to make the facts available, delays in

ROCKY FLATS PLANT

PUBLIC COMMENT PERIOD

Draft Final Groundwater Protection and Monitoring Program Plan

The U S. Department of Energy Rocky Flats Office has developed a Groundwater Protection and Monitoring Program Plan The primary objective of this plan is to assess the impact of a facility or site on the groundwater beneath it. The document summarizes the hydrogeology of the site major aquifers, movement of groundwater, potential sources of groundwater pollution and uses of groundwater at the site.

A 60-day comment period of the plan begins **Thursday, June 20, 1991 and ends Tuesday, August 20, 1991** Copies of the Rocky Flats Groundwater Protection and Monitoring Program Plan are available for review at the following reading rooms.

U S. Environmental
Protection Agency
Superfund Records Center
999 18th Street, 5th floor
Denver Colorado 80202 2405
303-293-1842

U S Department of Energy
Public Reading Room
Front Range Community
College Library
3645 West 112th Avenue
Westminster Colorado 80030
303-469-4435

Colorado Department of Health
4210 East 11th Avenue
Room 351
Denver Colorado 80220
303-331-6733

Rocky Flats Environmental
Monitoring Council
1536 Cole Boulevard
Suite 150 Building 4
Denver West Office Park
Golden Colorado 80401
303-232 1966 by appointment only

Boulder Public Library
1000 Canyon Blvd
Boulder CO 80306
303-441 3100

During the comment period the Rocky Flats Plant will hold a Public Information Workshop on the Draft Final Groundwater Protection and Monitoring Program Plan

THURSDAY, JULY 11, 1991
7P M. - 9P.M.
WESTMINSTER CITY PARK RECREATION CENTER
10455 SHERIDAN BOULEVARD
WESTMINSTER, CO

Written comments may be sent to GPMP Plan Comments Beth Brainard Public Affairs Officer U S. Department of Energy, Rocky Flats Office P O Box 928 Golden, Colorado 80402-0928

U S Department of Energy
Rocky Flats Office

PUBLIC COMMENT PERIOD NOTICE

GROUNDWATER PROTECTION
AND MONITORING PROGRAM PLAN

EG&G
Rocky Flats Plant, Golden, Colorado

FIGURE 8-1

the flow of information may result in the perception that information is being concealed. Planning timely responses and having a system for identification of controversial or noteworthy findings resulting from the groundwater monitoring program are crucial for keeping the community informed and maintaining public trust

For the above reasons, it is important for the personnel responsible for the groundwater protection and monitoring program to relay information to the public in a timely manner. This may involve tasks ranging from routine informational activities that update the community on the general progress of the studies to very interactive activities such as telephone notification and public meetings Community relations guidelines developed for the groundwater program will assist managers in determining quickly what level of response is appropriate when a potentially controversial situation is identified and what resources are available in the event that a situation requires more than routine community relations activities

The groundwater community relations program will involve four major activities associated with effective community relations programs assessment, planning, implementation, and training The approach to these four areas is outlined below

Assessment The critical first step is to determine what the RFP groundwater issues audiences are concerned about and what routine activities, such as briefings and presentations, will be required to keep them informed The initial assessment of community interest in the project as a whole can be determined from research and evaluation of existing community relations documents From this research, routine informational activities can be designed Along with determining what routine measures will be appropriate, the RFP will develop a checklist that will help determine a threshold for when a non-routine situation requires some level of community relations.

If it is determined that non-routine community relations activities are required, the situation should be evaluated against guidelines outlined in the checklist to determine what level and types of community relations are appropriate The checklist may include questions such as, "Will the public perceive this as 'news'?", "Has an unusually high level of contamination been identified?", and "Is it near drinking water supplies or residential areas?" By weighing answers to such questions in a given situation against the threshold criteria, it may be determined that a press release should be issued, a presentation made to local officials, and/or a public meeting held Depending on the nature of the information to be relayed, the audience may be large or small. The checklist will help managers assess quickly the appropriate level of community relations necessary

For each level of response, the appropriate audience will be identified with an accompanying contact list to include agencies, individuals, and communities potentially affected by the groundwater issues at the RFP These audiences will be drawn from Federal, State, and local government regulatory and elected officials, EG&G employees, facility neighbors, media, environmental and other special interest groups, and other community leaders

Planning To ensure the program accomplishes its objectives, a community relations strategy specific to groundwater monitoring will be developed This strategy will provide a framework from which program managers can determine what community relations activities are appropriate to a variety of situations For routine activities, such as periodic progress reports and public meetings, planning involves determining how frequently to schedule those activities For non-routine situations, where a problem is identified and the appropriate level of response determined, a plan of action will be integrated with the anticipated technical work needed at the site in order for the RFP personnel to respond effectively The level of planning needed will vary according to community interest and the nature of the situation The purpose of the strategy for both routine and non-routine activities is to ensure there is consensus about what community relations actions will be taken, when they will occur, and who is responsible for their implementation.

Implementation The community relations needs of each situation may span a wide range, from basic notification activities to direct interactions with the public and the media. The latter would involve such activities as conducting a "mini-" community assessment, disseminating fact sheets, briefing local officials and monitoring groups, issuing press releases, and holding public meetings. It is difficult to predict what community relations activities might be most appropriate in advance of developing the community relations strategy and objectives for the groundwater protection monitoring program. While a full-scale community relations effort may be unlikely for routine activities, the RFP will need to be aware of what resources are available to it and how to access them within a reasonable time frame In many cases, the need for expanded community relations will surface quickly and implementation of those activities may necessitate outside resources. The strategy should establish a framework for implementation that allows the RFP to gain the level of support it requires on short notice It is important that program managers know how to implement the appropriate community relations response and that they have the resources to do so

While the technical experts conduct studies and address policy, technical, and legal issues, it is essential to remain aware of, and responsive to, community sensitivities regarding groundwater issues One person should be designated as the contact for the program, who will respond when situations arise requiring the dissemination of information or when routine requests for information arrive This minimizes the possibility that conflicting information will be disseminated as new information surfaces.

Training An important part of ensuring good communication with the public is training technical staff in communication techniques An example of what such communication may need to accomplish is outlined below

Risk Communication

The challenge in communicating about risk is in recognizing when one is communicating about perceived versus actual risks. Perceived risks are those risks that individuals or groups believe exist when in fact, as measured by scientific methods, they do not. Communicating about perceived risks requires sensitivity and tact. Whether or not the risks exist, fear that they do is real, and must be addressed. Technical staff working closely on a project may not perceive new information on groundwater contamination in the same light as the community If groundwater modeling prior to drilling a monitoring well indicates that elevated levels of contamination will be found, the technical staff will not be alarmed when high concentrations are published in a monitoring report. The community may perceive these same levels of groundwater contamination quite differently Upon reading the same report months after the discovery, the community reaction may be quite strong Residents may believe the contamination presents significant health threats and that DOE should have notified them sooner. The reaction can be avoided or minimized if the technical staff keeps the community's perceptions in mind, both with respect to timeliness and the way information is presented to the public.

Likewise, communication about actual risks carries its own set of challenges. Technical staff must be precise when describing actual risks They must present information clearly and without causing either undue alarm or nonchalance. Establishing guidelines for community relations can avert many of these communication problems, however, it is also important that the technical staff involved understand the principles of risk communication. While the program or project manager may have the responsibility of communicating information to the public and the media, other technical staff will likely be required to give presentations or explain details To accommodate this, all technical staff who are likely to present controversial information to the public will be trained in risk communication. Learning the techniques of risk communication training can prepare the technical staff to relay information to the public in a sensitive and accurate manner.

References

Approved by:

J. W. Langman Jr. 2/18/92

Project Manager Date

Reviewed for Classification /UCNI

By: George H. Setlock

Date· 11/21/91 UNU

9.0 REFERENCES

Advanced Sciences, Inc (ASI), 1990, Water-Yield and Water-Quality Study of Walnut Creek and Woman Creek Watersheds, Rocky Flats Plant. Task 4 of the Zero-Offsite Water-Discharge Study, September 18

__________, 1991a, Solar Pond Interceptor Trench System Groundwater Management Study, Rocky Flats Plant Task 7 of the Zero-Offsite Water-Discharge Study, January 15

__________,1991b, (Predecisional) Consolidation and Zero-Discharge Plans Rocky Flats Plant Task 30 of the Zero-Offsite Water-Discharge Study, July 31

__________,1991c, Rainfall-Runoff Relationships Study, Rocky Flats Plant Task 5 of the Zero-Offsite Water-Discharge Study, June 18

__________, 1991d, Non-Point Source Assessment and Storm-Sewer Inflow/Infiltration and Exfiltration Study, Rocky Flats Plant. Tasks 2 and 3 of the Zero-Offsite Water-Discharge Study, September 30

__________, 1991e, Waste Generation Treatment Study, Rocky Flats Plant: Task 27 of the Zero-Offsite Water-Discharge Study, June 4

Bieber, David W , 1983, Gravimetric Evidence for Thrusting and Hydrocarbon Potential of the East Flank of the Front Range, Colorado, Rocky Mountain Association of Geologists

Colorado Department of Health (CDH), 1990, Notice of Violation No 90-03-28-01, March 28

Compliance Agreement, 1986, In the Matter of Department of Energy, RFP, Golden, Colorado, Signed by the Colorado Department of Health and the U.S Department of Energy

Dames & Moore, Inc , 1981, Final Report, Geologic and Seismologic Investigations for Rocky Flats Plant

Department of Energy (DOE), 1980, Final Environment Impact Statement, Rocky Flats Plant, Golden, Jefferson County, Colorado: Final Statement to ERDA 1545-D.

__________, 1985, Comprehensive Environmental Assessment and Response Program (CEARP) Phase 1 Installation Assessment

__________, 1987a, Comprehensive Environmental Assessment and Response Program (CEARP) Phase 2 RFP, Draft Installation Generic Monitoring Plan

__________, 1987b, Comprehensive Environmental Assessment and Response Program (CEARP) Phase 2 RFP, Draft Site Specific Monitoring Plan

__________, 1987c, Phase I Remedial Investigation, 903 Pad, Mound, and East Trenches, Operable Unit No 2, Medium Priority Sites.

__________, 1988a, DOE Order 5400 1, General Environmental Protection Program.

__________, 1988b, Solar Evaporation Ponds Closure Plan Vol. 1

__________, 1990a, Surface Water Management Plan.

__________, 1990b, Operable Unit 2 Interim Remedial Action Plan

EG&G Rocky Flats, Inc , 1990a, French Drain Geotechnical Investigation

__________, 1990b, Ground-water Assessment Plan Addendum

__________, 1990c, 1989 Annual RCRA Groundwater Monitoring Report for Regulated Units at Rocky Flats Plant

__________, 1990d, Draft Geologic Characterization Report for the Rocky Flats Plant.

__________, 1990e (Draft), Surface-Water Monitoring Plan

__________, 1990f, Operable Unit 2, Phase 2 Work Plan

__________, 1990g, Solar Pond Closeout Project Management Plan

__________, 1990h, General Radiochemistry and Routine Analytical Service Protocol, revised July 2, 1991

__________, 1991a, 1990 Annual RCRA Groundwater Monitoring Report for Regulated Units at Rocky Flats Plant

__________, 1991b, Draft Final Geologic Characterization Report for the Rocky Flats Plant

__________, 1991c, Task 3 Shallow, High-Resolution Seismic Reflection Profiling in Operable Unit 2 (903 Pad, East Trenches, and Mound) at the Rocky Flats Plant.

__________, 1991d, Final Phase III RFI/RI Work Plan Revision 1 for 881 Hillside Operable Unit 1

__________, 1991e, Draft Rocky Flats Surface Water Management Plan, 2 volumes, March

__________, 1991f, EG&G Environmental Management Division Operating Procedure GW 6, Groundwater Sampling

__________, 1991g, EG&G Environmental Management Division Operating Procedure GW 1, Water Level Measurements

__________, 1991h, EG&G Environmental Management Division Operating Procedure GW 2, Well Development

__________, 1991i, Quality Assuracne Project Plan, June

__________, 1991j, Rocky Flats Plant FY93 - FY97 Five Year Plan.

Environmental Protection Agency (EPA), 1985, Letter to James R. Nicks, USDOE RFP, From Robert L Duprey, Director of EPA Waste Management Division and Kenneth Waesche, Director of Colorado Department of Health Waste Management Division.

__________, 1988, Harzardous Waste Ground-Water Task Force, Ground-Water Monitoring Evaluation, U S Department of Energy, Rocky Flats Plant, Golden, Colorado

__________, 1989, Interim Final RCRA Facility Investigation (RFI) Guidance Volumes I and II, PB-89-200299

__________, 1991, Rocky Flats Interagency Agreement, Federal Facility Agreement and Consent Order, CERCLA-VIII-91-03, RCRA (3008(h))-VIII-91-07, State of Colorado Docket Number 91-01-22-01, January 22

Federal Register, 1990a, National Oil and Hazardous Substances Pollution Contingency Plan Final Rule, Volume 55 No 46 Thursday March 8

__________, 1990b, Proposed Rule, Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities, Volume 55, No. 145

Fetter, C W , 1988, Applied Hydrogeology, Merrill Publishing Co., 592p.

Freeze, R A , and Cherry, J A , 1979, Groundwater, Prentice-Hall, Inc. 604p.

Gries, R , 1983, North-South Compression of Rocky Mountain Foreland Structures, Rocky Mountain Association of Geologists

Hurr, R T , 1976, Hydrology of a Nuclear-Processing Plant Site, Rocky Flats, Jefferson County, Colorado, USGS Open-File Report 76-268

Hydro-Search, Inc , 1985, Hydrogeologic Characterization of the Rocky Flats Plant, Golden, Colorado, December 9

LeRoy, L W and Weimer, R J , 1971, Geology of the Interstate 70 Road Cut, Jefferson County, Colorado Colorado School of Mines Prof Contrib No 7

Merrick & Company, 1991, Preliminary Conceptual Design Document for Sanitary Landfill, April

Rockwell International, 1981, Groundwater Monitoring Program Plan, November 13.

___________, 1986a, RCRA Part B Permit Application.

___________, 1986b, Geological and Hydrological Site Characterization Draft Work Plan for Rocky Flats Plant

___________, 1986c, Resource Conservation and Recovery Act Post-Closure Care Permit Application, November 28

___________, 1986d, Geological and Hydrogeological Data Summary, Rocky Flats Plant.

___________, 1987, Remedial Investigation Report for 903 Pad, Mound, and East Trenches Areas

___________, 1989a, Ground-Water Assessment Plan

___________, 1989b, Phase II RI/FS Work Plan, Rocky Flats Plant, Pad 903, Mound and East Trenches Areas, Operable Unit 2

___________, 1989c, Catalogue of Monitoring Activities at Rocky Flats.

___________, 1989d, (draft), Background Geochemical Characterization Report.

Robson, S G , 1987, Bedrock Aquifers of the Denver Basin, Colorado -- A Quantitative Water-Resources Appraisal U S Geological Survey Professional Paper 1257, Prepared in Cooperation with the Colorado Department of Natural Resources, Office of the State Engineer, the Denver Board of Water Commissioners; and

Adams, Arapahoe, Douglas, Elbert and El Paso Counties, 73 p., 5 plates, (Supersedes Open-File Report 84-431)

Scott, G R , 1965, Nonglacial Quaternary Geology of the Southern and Middle Rocky Mountains, In The Quaternary of the United States, Wright, H E., Jr., and Frey, D G , eds , Princeton University Press, Princeton, NJ.

Scott, G R , 1975, Cenozoic Surfaces and Deposits in the Southern Rocky Mountains, In Cenozoic History of the Southern Rocky Mountains, Curtis, B F , ed., Geological Society of America Memoir 144

Spencer, F D , 1961, Bedrock Geology of the Louisville Quadrangle, Colorado, USGS Geological Quadrangle Map GQ-151, Lat 39°52'30" to 40°, Long. 105°07'30" to 105°15' Scale 1 24,000, Contour Interval 10 Feet.

Tweto, Ogden, 1975, Laramide (Late Cretaceous-Early Tertiary) Orogeny in the Southern Rocky Mountains, Geological Society of America, Memoir 144.

U S Army Corps of Engineers (COE), 1989, Dam Safety Periodic Inspection Report No. 2, RFP, Golden, Colorado Prepared for Department of Energy

Van Horn, R , 1957, Bedrock Geology of the Golden Quadrangle, Colorado, USGS Geological Quadrangle Map GQ-103, Lat 39°45' to 39°52'30", Long 105°07'30" to 105°15', Scale 1 24,000, Contour Interval 10 Feet.

Van Slyke, G , J Romero, G Moravec, and A Wacinski, 1988a, Geologic Structure, Sandstone/Siltstone Isolith, and Location of Non-Tributary Groundwater for the Arapahoe Aquifer, Denver Basin, Colorado, Denver Basin Atlas No. 3, DBA-3.

Van Slyke, G , J Romero, G Moravec, and A Wacinski 1988b Geologic Structure, Sandstone/Siltstone Isolith, and Location of Non-Tributary Groundwater for the Laramie-Fox Hills Aquifer, Denver Basin, Colorado. Denver Basin Atlas No. 4, DBA-4

Weimer, R J , 1973, A Guide to Uppermost Cretaceous Stratigraphy, Central Front Range, Colorado Deltaic Sedimentation, Growth Faulting, and Early Laramie Crustal Movement, Mountain Geologist, vol 10, no 3. p 53-97

Weimer, R J , 1976, Cretaceous Stratigraphy, Tectonics, and Energy Resources, Western Denver Basin, In Studies of Colorado Field Geology, CSM Professional Contributions No 8

APPENDICES

ROCKY FLATS PLANT GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN	Manual No: Procedure No.: Effective Date: Organization:	21000-MP-GPMP Appendix A, Rev 0 2/15/92 Environmental Management

Acronyms

Approved by

J. W. Langman Jr. 2/18/92

Project Manager Date

Reviewed for Classification /UCNI

By George H. Setlock

Date 11/21/91 UNU

APPENDIX A

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

ACRONYM LIST

AIP	Agreement in Principal
ADS	Activity Data Sheet
ANOVA	analysis of variance procedures
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ARARs	Applicable or relevant and Appropriate requirements
CAA	Clean Air Act
CAD	Corrective Action Decision
CAS	Chemical Abstracts Service
CCR	Colorado Code of Regulations
CDH	Colorado Department of Health
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CHWA	Colorado Hazardous Waste Act
CLP	Contract Laboratory Program
CMS/FS	Corrective Measure Study/Feasibility Study
COE	Corps of Engineers
CWA	Clean Water Act
CCL_4	Carbon tetrachloride
DOE	Department of Energy
DCA	Dichloroethane
EM	Environmental Management
EPA	Environmental Protection Agency
FFCA	Federal Facility Compliance Agreement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FS	Feasibility Study
FY	fiscal year
FYP	Five-Year Plan

ACRONYM LIST - Continued

GAC	granulated activated carbon
GPMPP	Groundwater Protection and Monitoring Program Plan
HRS	Hazard Ranking System
IAG	Inter-Agency Agreement
IGMP	Installation Generic Monitoring Plan
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
IRAP	Interim Remedial Action Plan
ITPH	Interceptor Trench Pump House
m y	million years
MANOVA	multivariate analysis of variance
NCP	National Contingency Plan
NEIC	National Enforcement Investigation Center
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NOV	Notice of Violation
NPL	National Priorities List
OPWL	Original Process Waste Lines
OU	Operable Unit
PA	Protected Area
PA/SI	Preliminary Assessment/Site Investigation
PCE	Perchloroethene
PVC	polyvinylchloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QAPD	Quality Assurance Program Description

ACRONYM LIST - Continued

RCRA	Resource Conservation and Recovery Act
RFEDS	Rocky Flats Environmental Database System
RFP	Rocky Flats Plant
RI/FS	Remedial Investigation/Feasibility Study
RFI/RI	RCRA Facility Investigation/Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendment and Reauthorization Act
SAS	Statistical Analysis System
SCH	Schedule
SDWA	Safe Drinking Water Act
SEN	Secretary of Energy
SOP	Standard Operating Procedures
SPCC	Spill Prevention/Contamination Control
SSAD	Sole Source Aquifer Demonstration
SSMP	Site-Specific Monitoring Plan
STP	Sanitary Treatment Plant
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCE	Trichloroethene
TCL	Target Compounds List
TDS	Total Dissolved Solids
TSCA	Toxic Substance Control Act
TSS	total suspended solids
USGS	U S Geological Survey
VOCs	volatile organic compounds
WARP	Well Abandonment and Replacement Program
WQCC	Water Quality Control Commission

ACRONYM LIST - Continued

Units of Measurement

ac	acre
ac-ft	acre feet
cm/sec	centimeters/second
ft	foot, feet
ft/yr	feet/year
gal	gallons
pCi/L	picoCuries per liter
ug/L	milligrams per liter
ug/L	micrograms per liter

Operable Units

Approved by·

J. W. Langman Jr.
Project Manager

2/18/92
Date

This is a
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Reviewed for Classification /UCNI

By George H. Setlock
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ROCKY FLATS PLANT GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN	Manual No : Procedure No.: Effective Date. Organization:	21000-MP-GPMP Appendix C, Rev 0 2/15/92 Environmental Management

Monitoring Well Network

Approved by

J. W. Langman / 2/18/92

Project Manager   Date

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ENVIRONMENTAL MANAGEMENT DEPARTMENT
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APPENDIX C

MONITORING WELL NETWORK

The current groundwater monitoring well network at RFP is comprised of 371 wells within the plant boundaries These wells were installed between 1960 and 1990 for the investigation of groundwater and hydrogeology Table C-1 through C-5 identify the wells in the groundwater monitoring program constructed in specific years. Each well in the program is identified by the well type and whether it is sampled quarterly and measured monthly for water table elevation Wells are assigned to one of five types determined by their function in the program The five types are as follows:

- **RCRA Wells** - Wells that monitor the uppermost aquifer and which are capable of 1) immediately detecting any statistically significant amounts of hazardous waste or hazardous waste constituents that migrate into the uppermost aquifer and 2) determining the rate and extent of migration of hazardous waste or hazardous waste constituents in the groundwater. RCRA wells are constructed in a manner consistent with the requirements of 6 CCR 1007-3 Section 265.91 There are 89 wells in the program designated as RCRA wells

- **CERCLA Wells** - Wells that are used for the characterization of RFI/RI activities as stated in 40 CFR Section 430(d). CERCLA groundwater monitoring is performed in a manner consistent with 40 CFR Section 300 430(e) Ninety-one CERCLA wells are in the program.

- **Boundary Wells** - The last monitoring wells located downgradient of RFP-affected areas There are three bedrock wells and five alluvial wells classified as boundary wells

- **Background Wells** - Wells that monitor the groundwater in areas upgradient or cogradient of RFP and that are unaffected by RFP operations. Twenty-eight alluvial wells and 23 bedrock wells are background wells.

- **Characterization Wells** - The remaining 94 wells in the groundwater monitoring program used to characterize the groundwater. For example, wells within a RCRA-regulated unit that monitor a hydrostratigraphic unit which is not the uppermost aquifer are characterization wells.

APPENDIX C

Table C-1

Pre-1986 Wells

Well Number	Well Type	Sampled Quarterly	Monthly Water Elevations	Location Identifier*
WS01				J12
WS02				L12
WS03				K11
160				M11
260	RCRA	*		M11
360				M10
460	RCRA	*		M10
560				M10
660				L10
166				H9
266				M11
366				N10
168				M9
268				M8
368				M8
468				M9
171	CERCLA	*		N8
271	CERCLA	*		M8
371				N11
471				N7
571				P11
671				L11
174	CERCLA	*		N9
374	CERCLA	*		O9
474				N9

Table C-1 - Continued

Pre-1986 Wells

Well Number	Well Type	Sampled Quarterly	Monthly Water Elevations	Location Identifier*
574				O9
674				O9
774				P9
874				P9
974	CERCLA	*		L8
1074	CERCLA	*		L7
1374				H7
1474				H7
1574				P7
1674	CERCLA	*		P7
1774				P11
1874				P11
2174				J8
2274	CERCLA	*		O9
181				R13
281				Q13
381				P11
481				J7
581				J7
681				J10
781	Character	*		J10
881	Character	*		G9
981	Character	*		G9
1081	RCRA	*		D8
182				M7
282				M7
382	CERCLA	*		H10

Table C-1 - Continued

Pre-1986 Wells

Well Number	Well Type	Sampled Quarterly	Monthly Water Elevations	Location Identifier*
482				G9
582	RCRA	*		F9
682	RCRA	*		F9
782	RCRA	*		D8
Total Pre-1986 Wells:	**56**			

* Coordinates on Plate 1

Note Pre-1986 RCRA wells may not meet the requirements for well-construction, but are useful in the RCRA monitoring program

Table C-2

1986 Wells

Well Number	Well Type	Sampled Quarterly	Monthly Water Elev	Location Identifier*
186	Boundary	*	*	U4
286	Boundary	*	*	U8
386	Boundary	*	*	U10
486	Boundary	*	*	U13
586	CERCLA	*		Q13
686	Character	*		N13
786	RCRA	*		K12
886	Character	*		K12
986	Character	*		J12
1086	RCRA	*	*	J12
1186	CERCLA	*		R13
1286	CERCLA	*		O12
1386	RCRA	*	*	N11
1486	Character	*		M11
1586	RCRA	*		M11
1686	Character	*		M11
1786	RCRA	*	*	M11
1886	RCRA	*	*	M11
1986	Character	*	*	K10
2086	RCRA	*	*	L11
2186	Character	*		J10
2286	RCRA	*		L10
2386	Character	*		L10
2486	RCRA	*	*	L10
2586	Character	*		L10
2686	RCRA	*	*	L10
2786	Character	*		M10

Table C-2 - Continued

1986 Wells

Well Number	Well Type	Sampled Quarterly	Monthly Water Elev	Location Identifier*
2886	RCRA	*	*	M10
2986	RCRA	*	*	M10
3086	RCRA	*		L11
3186	Character	*		L11
3286	Character	*		L11
3386	Character	*		L9
3486	CERCLA	*		N10
3586	CERCLA	*		N10
3686	CERCLA	*		N10
3786	CERCLA	*		P11
3886	CERCLA	*		R12
3986	Boundary	*		R11
4086	CERCLA	*		P9
4186	CERCLA	*	*	P9
4286	CERCLA	*	*	O9
4386	CERCLA	*	*	M9
4486	Character	*	*	J9
4586	CERCLA	*	*	G10
4686	Character	*		F10
4786	Character	*	*	F10
4886	Character	*		F8
4986	RCRA	*		F8
5086	RCRA	*	*	E7
5186	RCRA	*	*	D8
5286	Character	*		D8
5386	CERCLA	*		F6
5486	Character	*	*	F5

Table C-2 - Continued

1986 Wells

Well Number	Well Type	Sampled Quarterly	Monthly Water Elev	Location Identifier*
5586	Background	*	*	F5
5686	CERCLA	*		H7
5786	CERCLA	*		I7
5886	CERCLA	*		K7
5986	CERCLA	*	*	L7
5986R	CERCLA			L7
6186	Character	*	*	K9
6286	CERCLA	*		M8
6386	CERCLA	*	*	M8
6486	CERCLA	*		M7
6586	CERCLA	*		O7
6686	CERCLA	*	*	S6
6786	Boundary	*		R8
6886	CERCLA	*		K7
6986	CERCLA	*		L7
7086	CERCLA	*		I7
Total 1986 Wells:	70			

* Coordinates on Plate 1

Table C-3

1987 Wells

New Well Number	Well Type	Sampled Quarterly	Monthly Water Elev	Location Identifier
187	CERCLA	*		K8
287	CERCLA	*	*	K7
387	CERCLA	*		K7
487	CERCLA	*	*	L7
587	CERCLA	*		L8
687	CERCLA	*		M8
887	CERCLA	*		L7
987	CERCLA	*		M9
1087	CERCLA	*	*	M8
1187	CERCLA	*		N8
1287	CERCLA	*		N8
1487	CERCLA	*		N8
1587	CERCLA	*	*	N9
1687	CERCLA	*		N9
1787	CERCLA	*	*	N9
1887	CERCLA	*		N9
1987	CERCLA	*		N9
2087	CERCLA	*		N9
2187	CERCLA	*		M9
2287	CERCLA	*		M9
2387	CERCLA	*		M9
2487	CERCLA	*	*	N9
2587	CERCLA	*		N9
2687	CERCLA	*	*	O9
2787	CERCLA	*	*	P9
2887	CERCLA	*		P9
2987	CERCLA	*		O8
3087	CERCLA	*		O8

Table C-3 - Continued

1987 Wells

New Well Number	Well Type	Sampled Quarterly	Monthly Water Elev	Location Identifier
3187	CERCLA	*	*	P9
3287	CERCLA	*	*	P9
3387	CERCLA	*	*	O9
3487	CERCLA	*		O9
3587	CERCLA	*	*	O9
3687	CERCLA	*	*	O9
3787	RCRA	*	*	M10
3887	RCRA	*		M10
3987	Character	*		M11
4087	RCRA	*	*	L13
4187	Character	*		L13
4287	CERCLA	*	*	M13
4387	CERCLA	*	*	L8
4487	CERCLA	*	*	M8
4587	CERCLA	*		M8
4787	CERCLA	*	*	L7
4887	CERCLA	*		L7
4987	CERCLA	*		M7
5087	CERCLA	*		M8
5187	CERCLA	*		K8
5287	CERCLA	*		L8
5387	CERCLA	*		K7
5487	CERCLA	*	*	L7
5587	CERCLA	*	*	L7
5687	RCRA	*	*	L10
5887	RCRA	*		J12
5987	RCRA			J12

Table C-3 - Continued

1987 Wells

New Well Number	Well Type	Sampled Quarterly	Monthly Water Elev	Location Identifier
6087	RCRA	*		K12
6187	RCRA	*		K12
6287	RCRA	*		K12
6387	RCRA	*	•	K12
6487	RCRA	*	*	K12
6587	RCRA	*		K12
6687	RCRA	*		K12
6787	RCRA	*	*	K13
6887	RCRA	*		K13
7087	RCRA	*	*	L12
7187	RCRA	*		L13
7287	RCRA	*		K12
Total 1987 Wells: 67				

Table C-4

1989 Wells

New Well Number	Old Well Number	Well Type	Sampled Quarterly	Monthly Water Elev.	Location Identifier*
089	189P	Character			F4
189	189A	Background	*		F4
289	289	Background	*		G4
389	389	Background	*		F3
489	489	Background	*		G3
589	589	Background	*	*	K14
689	689	Background	*		L15
789	789	Background	*		M15
889	889	Background	*	*	M16
1089	989	Background	*	*	O15
1189	1089	Background	*		N17
1289	1189	Background	*	*	K17
1489	1289	Background	*		M17
1589	1389	Background	*		N17
1889	1489	Background	*		M7
1989	1589	Background	*		I5
2089	1689	Background	*		K6
2189	1789BR	Background	*		I6
2289	1889	Background	*	*	G13
2389	1989	Background	*		H13
2489	2089	Background	*	*	K17
2589	2189	Background	*		M18
2689	2289	Background	*		F7
2789	2389	Background	*		N4
2889	2489	Background	*		Q5
2989	2589	Background	*	*	S5
3089	2689	Background	*		U2
3189	2789BR	Background	*	*	K14

Table C-4 - Continued

1989 Wells

New Well Number	Old Well Number	Well Type	Sampled Quarterly	Monthly Water Elev	Location Identifier*
3289	2889BR	Background	*		L15
3489	2989BR	Background	*		M15
3589	3089BR	Background	*		M16
3689	3189BR	Background			N16
3789	3289BR	Background	*		M15
3889	3389BR	Background	*	*	M16
3989	3489BR	Background	*		N16
4089	3589BR	Background	*		O14
4189	3689BR	Background	*		P15
4289	3789BR	Background	*		N4
4589	3789P	Character			N4
4689	3889BR	Background			N14
4789	3989BR	Background	*		M7
4889	4089BR	Background	*		Q5
4989	4189BR	Background	*		Q5
5189	4289BR	Background	*		J6
5289	4389BR	Background	*		J6
5389	4489BR	Background	*		N4
5489	4589BR	Background	*		F5
5589	4689	Background	*		N17
5689	4789	Background	*		G3
5789	4889	Background	*		I6
5889	4989BR	Background	*		I6
5989	5089	Background	*		I6
6089	LF 0189	RCRA	*	*	J12
6189	LF 0289BR	RCRA	*		K12
6289	LF 0389BR	RCRA	*		K12
6389	LF 0489	RCRA	*		K12

Table C-4 - Continued

1989 Wells

New Well Number	Old Well Number	Well Type	Sampled Quarterly	Monthly Water Elev	Location Identifier*
6489	LF 0589	RCRA	*		K12
6589	LF 0689BR	RCRA	*		L12
6689	LF 0889BR	RCRA	*		L12
6789	LF 0989BR	RCRA	*		L12
6889	LF 1089BR	RCRA	*		L12
6989	LF 1189BR	RCRA	*		L13
7089	LF 1289BR	RCRA	*		L13
7189	LF 1389BR	Character	*		L13
7289	LF 1489BR	RCRA	*		L13
7389	SEP0189BR	Character	*		L10
7489	SEP 0289	RCRA	*	*	L10
7589	SEP0389BR	RCRA	*		L10
7689	SEP0489	RCRA	*		M10
7789	SEP0589BR	RCRA	*		M10
7889	SEP 0689	RCRA	*		M10
7989	SEP0789BR	RCRA	*		M10
8089	SEP 0889	RCRA	*	*	M11
8189	SEP0989BR	RCRA	*		M11
8289	SEP1089BR	RCRA	*		N11
8389	SEP 1189	RCRA	*		M11
8489	SEP1289BR	RCRA	*		M11
8589	SEP 1389	RCRA	*		M11
8689	SEP1489BR	RCRA	*		M11
8789	SEP 1589	RCRA	*	*	L11
8889	SEP1689BR	Character	*		M11
8989	SEP1789BR	RCRA	*		L11
9089	SEP1889BR	RCRA	*		L10
9189	SE1989BR	RCRA	*		L10

Table C-4 - Continued

1989 Wells

New Well Number	Old Well Number	Well Type	Sampled Quarterly	Monthly Water Elev	Location Identifier*
9289	SEP 2089	RCRA	*	•	L10
9389	SEP2189BR	Character	*		L10
9489	SEP2289BR	RCRA	*		L10
9589	SEP2389BR	RCRA	*		M11
9689	SEP 2489BR	RCRA	*		M10
9789	SEP 2589	RCRA	*		M10
9889	SEP 2689BR	RCRA	*		L11
9989	SEP 2889	RCRA	*	*	L11
10089	SEP 2989BR	RCRA	*		L11
10189	SEP 3089BR	RCRA	*		L10
10289	SEP3189BR	RCRA	*		M10
10389	SEP 3289BR	RCRA	*		M11
10489	SEP 3389	RCRA	*	*	M11
10589	SF 0189	RCRA	*		E7
10689	SF 0289	RCRA	*	*	F8
10789	SF 0389	RCRA	*	*	G8
10889	SF 0489	RCRA	*		G9
10989	SF 0589	RCRA	*	*	F9
11189	SF 0689	RCRA	*	*	E9
11289	SF 0789	RCRA	*		D8
11389	SF 0889	RCRA	*	*	E8
13489	PZ 0589	Character		*	K8
13589	PZ 0789	Character		•	K8
13689	PZ 1089	Character		*	K9
13789	PZ 1389	Character			N10
13889	PZ 1489	Character		*	N10
13989	PZ 1489a	Character			N10
14089	PZ 2389	Character		*	K9

Table C-4 - Continued

1989 Wells

New Well Number	Old Well Number	Well Type	Sampled Quarterly	Monthly Water Elev	Location Identifier*
14189	PZ 2489	Character		*	J9
14289	PZ 3189	Character		*	K8
14389	PZ 3589	Character		*	I10
14489	PZ 3689	Character		*	I10
14589	PZ 3789	Character		*	I10
14689	PZ 4289	Character		*	K9
14789	PZ 4389	Character		*	J9
14889	PZ 4489	Character		*	J9
14989	PZ 4589	Character		*	I9
15089	PZ 4689	Character		*	I9
15489	PZ 4989	Character		*	J9
15589	PZ 5089	Character		*	J9
15689	PZ 5189	Character		*	K9
15789	PZ 5289	Character		*	K9
15889	PZ 5389	Character		*	H9
15989	PZ 5489	Character		*	I9
16089	PZ 5589	Character		*	H8
16189	PZ 5689	Character		*	I8
16289	PZ 5789	Character		*	I8
16389	PZ 5889	Character		*	H8
16489	PZ 5989	Character		*	I8
16589	PZ 6089	Character		*	I8
16689	PZ 6189	Character		*	I8
16789	PZ 6289	Character		*	J8
16889	PZ 6389	Character		*	J8
16989	5189BR	Character			I8
17189	5389BR	BNDRY		*	U8
17289	5489BR	BNDRY		*	U10

Table C-4 - Continued

1989 Wells

New Well Number	Old Well Number	Well Type	Sampled Quarterly	Monthly Water Elev	Location Identifier*
17489	5689BR	Character			N9
17589	5789BR	Character			O9
17689	5889BR	Character			N9
17789	6089BR	Character			O9
17989	OP 0289	Character	*	*	L8
18089	OP 0389	Character	*		L9
18289	OP 0189	Character	*		J8
18389	PZ 2789	Character		*	M10
18789	6489	CERCLA	*	*	N9
19189	PZ 1889	Character			L11
19389	PZ 3889	Character		*	I10
19489	PZ 1589	Character			M10
19589	PZ 1289	Character			M10
19689	PZ 0489	Character		*	J8
19889	6889	Character			Q5
19989	6989	Character			N9
20089	7089	Character	*		K8
20189	7189	CERCLA			N9
20489	7489	CERCLA			O9
20589	7589	CERCLA			L7
Total 1989 Wells: 160					

* Coordinates on Plate 1

Table C-5

1990 Wells

New Well Number	Old Well Number	Well Type	Sampled Quarterly	Monthly Water Elev	Location Identifier*
190	TH 10W	Character			H11
290	TH 2W	Character			G12
390	TH 1W	Character			F11
490	TH 5W	Character			G11
590	TH 21W	Character			G5
690	TH 27W	Character			H5
790	TH 24W	Character			G4
890	TH 26W	Character			G4
990	TH 30W	Character			H4
1090	TH 19W	Character			J14
1190	TH 17W	Character			J13
1290	TH 13W	Character			I12
1390	TH 11W	Character			H12
1490	TH 8AW	Character			G10
3390		CERCLA			M8
3490		CERCLA			M8
3590		CERCLA			M8
3690		CERCLA			M8
Total 1990 Wells: 18					

* Coordinates on Plate 1

ROCKY FLATS PLANT		Manual No.:	21000-MP-GPMP
GROUNDWATER PROTECTION		Procedure No.:	Appendix D, Rev 0
AND MONITORING PROGRAM PLAN		Effective Date:	2/15/92
		Organization·	Environmental Management

Water Quality Control Commission Standards

Approved by:

J. G. Langmo 2/18/92

Project Manager Date

Reviewed for Classification /UCNI

By George H. Setlock

Date. 11/21/91 UNU

APPENDIX D

WATER QUALITY CONTROL COMMISSION STANDARDS

STATE OF COLORADO

WATER QUALITY CONTROL COMMISSION
4210 East 11th Avenue
Denver Colorado 80220
Phone (303) 331-4525

NOTICE OF FINAL ADOPTION

PURSUANT to the provisions of Section 24-4-103(5) and 24-4-103(11), C.R.S.:

NOTICE IS HEREBY GIVEN that the Colorado Water Quality Control Commission, after public hearing on February 4 and 5, 1991, and complying with the provisions of 24-4-103(3), 25-8-401(1), and 25-8-402(1), C.R.S., adopted on March 5, 1991, pursuant to 25-8-202(1), (a), (b), and (2); 25-8-203 and 25-8-204; C.R.S., and section 2.1.3 of the Procedural Rules, a regulation titled:

"Classifications and Water Quality Standards for Ground Water" 3.12.0

Providing for water quality classifications and standards for ground water in the vicinity of Rocky Flats.

Also, pursuant to 24-4-103(8)(b), C.R.S., this regulation was submitted to the Attorney General for review and was found to be within the authority of the Water Quality Control Commission to promulgate, and further that there are no apparent constitutional deficiencies in its form or substance. Furthermore, in adopting this regulation the Commission adopted a general Statement of Basis, Specific Statutory Authority, and Purpose in compliance with 24-4-103(4), C.R.S.

This regulation will be submitted to the Office of Legislative Legal Services within twenty (20) days after the date of the Attorney General's Opinion, pursuant to 24-4-103(8)(d), C.R.S., and to the Secretary of State in time for April, 1991 publication in the Colorado Register pursuant to 24-4-103(5), and (11)(d), C.R.S., and will become effective April 30, 1991.

A copy of said regulation is attached and made a part of this notice*.

Dated this 15th day of March, 1991, at Denver, Colorado.

WATER QUALITY CONTROL COMMISSION

Marla L. Biberstine

Marla L. Biberstine, Staff Assistant

*A copy of this regulation is available at a charge of $2.00, pursuant to 24-4-103(9), C.R.S.

3807m/0246m

3.12.0 CLASSIFICATIONS AND WATER QUALITY STANDARDS FOR GROUND WATER

3.12.1 AUTHORITY

These regulations are promulgated pursuant to Section 25-8-202, 25-8-203 and 25-8-204 of the Colorado Water Quality Control Act, and according to the provisions of "The Basic Standards for Ground Water 3.11.0 (5 CCR 1002-8)," as specifically provided for in Section 3.11.4 and 3.11.5.

3.12.2 PURPOSE

The purpose of these regulations is to apply the framework for ground water classifications and water quality standards, as set forth in "The Basic Standards for Ground Water 3.11.0 (5 CCR 1002-8)" to specific ground waters in the state.

3.12.3 INTRODUCTION

These regulations establish the use classifications and water quality standards for ground water in specific areas of the state.

3.12.4 DEFINITIONS

(RESERVED)

3.12.5 CLASSIFICATIONS AND WATER QUALITY STANDARDS FOR UNCONFINED GROUND WATER SYSTEMS

(RESERVED)

3.12.6 CLASSIFICATIONS AND WATER QUALITY STANDARDS FOR CONFINED GROUND WATER SYSTEMS

(RESERVED)

3.12.7 SITE-SPECIFIC GROUND WATER CLASSIFICATIONS AND WATER QUALITY STANDARDS

(1) ROCKY FLATS AREA, JEFFERSON AND BOULDER COUNTIES

(a) Specified Area: All unconfined ground waters within the saturated zone of the unconsolidated Quaternary aquifer, the Rocky Flats aquifer, the Arapahoe aquifer, and the Laramie-Fox Hills aquifer, within the area shown on Figure 1.

(b) Classification: The classification of the ground waters within the specified area is:

1. Quaternary and Rocky Flats Aquifers:

   - Domestic Use-Quality

   - Agricultural Use-Quality

   - Surface Water Protection

2. Arapahoe and Laramie-Fox Hills aquifers:

   - Domestic Use Quality

   - Agricultural Use-Quality

(c) Water Quality Standards:

(i) The water quality standards included in Tables 1-4 of "The Basic Standards for Ground Water: 3.11.0 (5 CCR 1002-8)" (reprinted on the following pages for informational purposes) are assigned to all ground waters described in 3.12.7(1)(a).

(ii) In addition, the water quality standards in Tables 5 and 6 are assigned to ground water in the quaternary and Rocky Flats Aquifers. The radionuclide standards in Table 6 for Segment 4 and Segment 5, Woman Creek, shall apply to those ground waters that are hydraulically connected to Woman Creek; similarly, those radionuclides for Segment 4 and Segment 5, Walnut Creek, shall apply to those ground waters hydraulically connected to Walnut Creek.

(iii) An agency implementing the standards in Tables 1 through 6 may, if it has authority, set a compliance standard different from the listed standard and equal to the background level of a constituent where background level is determined pursuant to the implementing agency's authority to exceed that standard.

(iv) Where a toxic substance for which no numerical standard has been established is found in a detectable amount, notification shall be given as soon as possible to the operator of the Rocky Flats Plant; the United States Department of Energy; the United States Environmental Protection Agency; and the Water Quality Control Division, which will consult as necessary with other components of the Colorado Department of Health. Those entities will meet and attempt to reach a consensus concerning the appropriate numerical protection level for that substance. If consensus is achieved, the Division shall establish that number as a numerical protection level. Where consensus cannot be reached, the Division will determine the appropriate numerical protection level

In setting a numerical protection level, the entities listed above will consider the existing and any reasonably probable future beneficial uses of ground water that need to be protected in the vicinity of the discharge, and establish the appropriate corresponding numerical protection levels for specific contaminants, based on those beneficial uses, as outlined in section 3.11.5(b) of "The Basic Standards for Ground Water." The entities will take into account reasonably available information.

A determination made by these entities or the Division in accordance with the procedure described above will not be deemed to constitute a ground water quality standard and will not be applicable outside the specified area for this hearing.

If numerical protection levels are established by agreement of the entities, they will jointly petition the Commission for rulemaking to set a standard at the numerical protection level. If the Division establishes a numerical protection level without agreement of all entities, the Division shall ask the Commission to set a standard consistent with the numerical protection level.

If any interested person disagrees with a determination made by the Division in accordance with the procedure described above, it may petition the Commission to adopt a site-specific standard different from the numerical protection level. Any determination made by the Commission during the hearing process would then become binding on the Division, the Department of Energy, and the operator of the Rocky Flats Plant. At the request of the Department of Energy or the operator of the Rocky Flats Plant or an interested person, the Commission will consider such a hearing to be madatory and de novo.

FIGURE 1

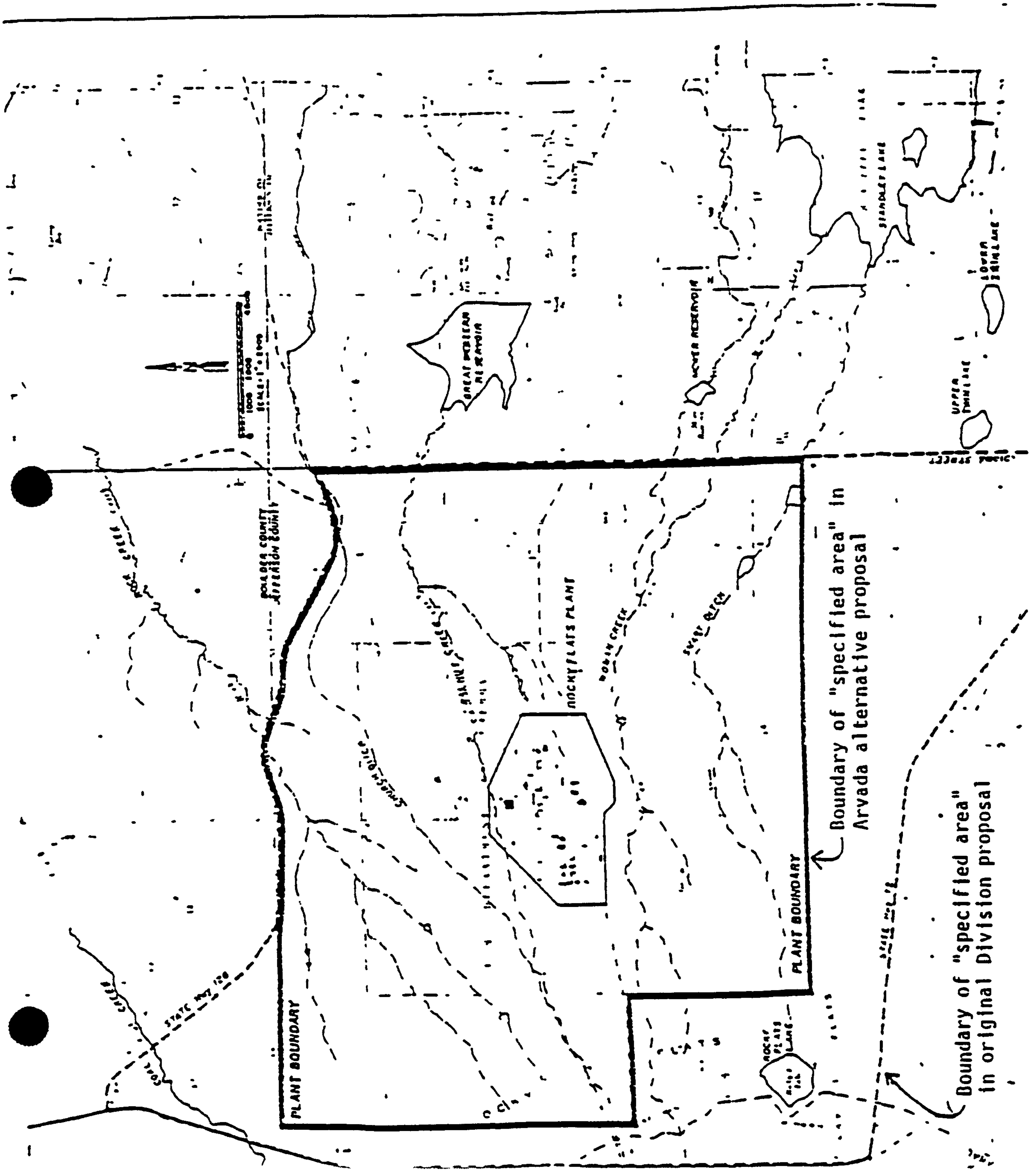
Boundary of "specified area" in Arvada alternative proposal
Boundary of "specified area" in original Division proposal
PLANT BOUNDARY
PLANT BOUNDARY
PLANT BOUNDARY
ROCKY FLATS PLANT
GREAT WESTERN RESERVOIR
STANDLEY LAKE
LOWER TWIN LAKE
UPPER TWIN LAKE
WOMAN CREEK
BOULDER COUNTY
JEFFERSON COUNTY
STATE HWY 128

TABLE 1
Human Health Standards

Contaminants		Standards	
Biological			
Total Coliforms		K[a] 1	org/100 ml
Inorganic			
Arsenic	(As)[d]	0.05	mg/l
Barium	(Ba)[d]	1.0	mg/l
Cadmium	(Cd)[d]	0.010	mg/l
Chromium	(Cr)[d]	0.05	mg/l
Cyanide [Free]	(CN)	0.20	mg/l
Fluoride	(F)[d]	4.0	mg/l
Lead	(Pb)[d]	0.05	mg/l
Mercury	(Hg)[d]	0.002	mg/l
Nitrate	(NO_3)[d]	10.0	mg/l as N
Nitrite	(NO_2)[d]	1.0	mg/l as N
Selenium	(Se)[d]	0.01	mg/l
Silver	(Ag)[d]	0.05	mg/l
Radiological[b d]			
Alpha Emitters			
Gross Alpha Particle Activity (excluding Radon and Uranium)		15	pCi/l
Beta and Photon Emitters[e]		4	mrem/year
Organic			
Chlorophenol		0.001	mg/l
Phenol		0.001	mg/l

TABLE 2

Secondary Drinking Water Standards

Contaminants		Level	
Chloride	(Cl)[d]	250	mg/l
Color		15 color units	
Copper	(Cu)[d]	1	mg/l
Corrosivity		Noncorrosive	
Foaming Agents	0.5	mg/l	
Iron	(Fe)[d]	0.3	mg/l
Manganese	(Mn)[d]	0.05	mg/l
Odor		3 threshold odor numbers	
pH		6.5 -	8.5
Sulfate	(SO_4)[d]	250	mg/l
Zinc	(Zn)[d]	5	mg/l

TABLE 3

Agricultural Standards

Contaminants		Level	
Aluminum	(Al)[df]	5.0	mg/l
Arsenic	(As)[d]	0.1	mg/l
Beryllium	(Be)[d]	0.1	mg/l
Boron	(B)[dg]	0.75	mg/l
Cadmium	(Cd)[d]	0.01	mg/l
Chromium	(Cr)[d]	0.1	mg/l
Cobalt	(Co)[d]	0.05	mg/l
Copper	(Cu)[d]	0.2	mg/l
Fluoride	(F)[d]	2.0	mg/l
Iron	(Fe)[d]	5.0	mg/l
Lead	(Pb)[df]	0.1	mg/l
Lithium	(Li)[dh]	2.5	mg/l
Manganese	(Mn)[d]	0.2	mg/l
Mercury	(Hg)[df]	0.01	mg/l
Nickel	(Ni)[d]	0.20	mg/l
Nitrite	$(NO_2\text{-}N)$[df]	10	mg/l as N
Nitrite & Nitrate	$(NO_2+NO_3\text{-}N)$[df]	100	mg/l as N
Selenium	(Se)[d]	0.02	mg/l
Vanadium	(V)[d]	0.1	mg/l
Zinc	(Zn)[d]	2.0	mg/l
pH		6.5 - 8.5	

TABLE 4

TDS Water Quality Standards

Background TDS Value (mg/l)	Maximum Allowable TDS Concentrations
0 - 500	400 mg/l or 1.25 times the background level, whichever is least restrictive
501 - 10,000	1.25 times the background value
10,001 or greater	No limit

a K Means less than. When the Membrane Filter Technique is used for analysis, the average of all samples taken within a year must be less than 1 organism per 100 milliters of sample. When the Filter Tube Method is used for analysis, the limit is less than 2.2 org/100 ml.

b If the identity and concentration of each radionuclide in a mixture are known, the limiting value would be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit specified. The sum of such ratios for all radionuclides in the mixture shall not exceed "1" (i.e. unity). A radionuclide may be considered as not present in a mixture if the ratio of the concentration to the limit does not exceed 1/10 and the sum of such ratios for all radionuclides considered as not present in the mixture does not exceed 1/4.

c ND Means none detected using an approved analytical method with the lowest detection limit for the parameter.

d Measured as dissolved concentration. The sample water shall be filtered through a 0.45 micron membrane filter prior to preservation. The total concentration (not filtered) may be required on a case-by-case basis if deemed necessary to characterize the pollution caused by the activity.

e If two or more radionuclides are present, the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 mrem per year. Except for Tritium and Strontium 90 the concentration of man-made radionuclides causing 4 mrem total body or organ dose equivalents shall be calculated on the basis of a 2 liter per day drinking water intake using the 168-hour data listed in "Maximum Permissible Body Burden and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure," NBS Handbook 69, as amended, August 1963, US Department of Commerce.

Table 5
ADDITIONAL ORGANIC CHEMICAL STANDARDS (1)
(ug/L)

Parameter	EPA Method	Chronic Standard	Detection Levels Gas Chromatography (GC)
Acrylonitrile	625	0.058	15*
Aldrin	508	0.0000784	0.1
Atrazine	608 (2)/507(3)	3.0	1.0
Benzidine	625	0.00012	10*
Chlordane	508	0.00046	0.1
Chloroform	502.2	0.19	1.0
Chloroethyl Ether (BIS)	625	0.0000037	10*
DDT	508	0.000024	0.1
Dichlorobenzidine	625	0.01	10*
Dieldrin	508	0.000071	0.1
Dioxin (2,3,7,8OTCDD)	613	0.000000013	0.01
Halomethanes	502.2	0.19	1.0
Heptachlor	508	0.00028	0.1
Hexachloroethane	525	1.9	1.0
Hexachlorobenzene	525	0.00072	1.0
Hexachlorobutadiene	525	0.45	1.0
Hexachlorocyclohexane, Alpha	505	0.0092	0.1
Hexachlorocyclohexane, Beta	505	0.0163	0.1
Hexachlorocyclohexane, Gamma (Lindane	505	0.0186	0.1
Hexachlorocyclohexane, Technical	505/608	0.0123	0.5
Nitrosodibutylamine N	607	0.0064	5
Nitrosodiethylamine N	607	0.0008	5
Nitrosodimethylamine N	607	0.0014	5
Nitrosodiphenylamine N	607	4.9	10
Nitrosopyrrolidine N	625	0.016	10
PCBs	508	0.000079	1.0
Polynuclear Aromatic Hydrocarbons	610	0.0028	1.0
Simazine	608(1)/507(2)	4.0	1.0
Tetrachloroethane 1,1,2,2	502.2	0.17	1.0
Tetrachloroethylene	502.2	0.8	1.0
Trichloroethane 1,1,2	502.2	0.6	1.0
Trichlorophenol 2,4,6	502.2	1.2	1.0

(1) In the absence of specific, numeric standards for non-naturally occurring organics, the narrative standard "no toxics in toxic amounts" (Section 3.1.11(1)(d)) shall be interpreted and applied in accordance with the provisions of section 3.12.7(1)(c)(iv).

(2) Extraction Method

(3) Analytical Method

Table 6
SITE SPECIFIC RADIONUCLIDE STANDARDS*
(in Picocuries/Liter)

A. Ambient based site-specific standards for ground waters in the Quaternary and Rock Aquifers hydraulically connected to the surface streams shown:

	Segment 4 Segment 5 Woman Creek	Segment 4 Segment 5 Walnut Creek
Gross alpha	7	11
Gross Beta	5	19
Plutonium	.05	.05
Americium	.05	.05
Tritium	500	500
Uranium	5	10

*Statewide Standards also apply for radionuclides not listed above.

3592m/0155m/jf

3.12.10 Statement of Basis, Specific Statutory Authority, and Purpose (1991 Rocky Flats Hearing)

The provisions of C.R.S. 25-8-202(1)(a), (b), and (2); 25-8-203, and 25-8-204 provide the specific statutory authority for adoption of these regulatory provisions. The Commission also has adopted, in compliance with C.R.S. 24-4-103(4), the following statement of Basis and Purpose.

BASIS AND PURPOSE.

Jurisdictional Issues

EG&G and DOE jointly raised 2 issues which questioned the Commission's jurisdictional authority to promulgate the ground water standards and classifications in this proceeding. These parties argued that the Commission has no authority to regulate the Rocky Flats facility as there has been no waiver of sovereign immunity for the application of ground water standards and classifications at federal facilities. EG&G and DOE asserted that the waiver of sovereign immunity found in the federal Clean Water Act did not provide clear and unambiguous authority for states to regulate ground water at federal facilities because the provisions of the Act were not intended to apply to ground water. Secondly, EG&G and DOE argued that the Commission has no authority to regulate the discharge of radionuclides, in particular plutonium, as the Atomic Energy Act preempts such regulation.

Briefs were submitted on these issues by interested parties, and, after careful consideration, the Commission has determined that it has jurisdiction to promulgate the regulation pursuant to its authority under the Colorado Water Quality Control Act. The Commission's decision is based, in part, on the knowledge that standards and classifications are not self-implementing, but are used, as appropriate, by the Division and other agencies through their own water pollution control programs. The promulgation of standards and classifications alone does not confer any authority to regulate any particular discharger, and it is not the Commission's intention to attempt through this rulemaking to override any preemption of the Atomic Energy Act. This decision is consistent with the Commission's promulgation in 1990 of surface water quality standards and classifications for Walnut Creek and Woman Creek.

Classifications

The basis for classifying specific ground waters of the state is set forth in the Basic Standards for Ground Water Section 3.11.10. Classification of the ground waters at the Rocky Flats site was requested by the City of Westminster. The intent of this classification is to protect specified ground water from uncontrolled degradation and thereby protect existing and future uses of that water.

The classifications of Domestic Use-Quality and Surface Water Quality Protection are appropriate for the Rocky Flats alluvium and Quaternary deposits which discharge into classified surface water segments. Classified segments of Walnut and Woman Creeks contribute to drinking water for 180,000 residents of Broomfield, Westminster, Thornton and Northglenn through Great Western Reservoir and Standley Lake. These segments also have Recreational Class 2, Aquatic Life Class 2 and Agricultural classifications through the "Classifications and Numeric Standards South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin" 3.8.0.

Numerical Standards

The water quality standards in Tables 1-4 of the Basic Standards for Ground Water are appropriately assigned to all aquifers in the specified area because these standards are set to fully protect the classified uses and because ambient quality is generally better than these standards. It is not necessary to establish standards for pollutants not currently found in the list of statewide standards for organic chemicals since current information indicates that techniques for remediation of the site to the level of established standards will also reduce those contaminants without standards to acceptable levels.

It is appropriate to apply the surface water quality standards for Woman Creek and portions of Walnut Creek (Segment 4, Big Dry Creek) to the shallow aquifers at Rocky Flats because they contribute water to those streams which the Commission recently protected with more stringent standards.

The Commission has decided not to set standards equal to background levels at this hearing. The characterization of background in the vicinity of the Rocky Flats Plant is an ongoing process, and the Commission believes that the agencies charged with implementing the remedial action at the plant under RCRA and CERCLA -- the Colorado Hazardous Materials and Waste Management Division and the United States Environmental Protection Agency -- may have an opportunity to determine background levels as part of the overall remedial action at Rocky Flats. The implementing agencies may also have authority to set compliance standards on a constituent-specific basis for constituents where background levels exceed the standards, or the Commission may set standards at background when sufficient evidence is available to it.

Similarly, if the Water Quality Control Division has regulatory jurisdiction over an activity at the Rocky Flats Plant, the Division may consider background levels when enforcing permit conditions, if consistent with Division enforcement authority and policy then in effect.

Plutonium Standard

There was considerable debate in this hearing regarding the appropriate basis for and numerical level of a plutonium standard for ground water in the vicinity of Rocky Flats. A standard of 0.05 picocuries per liter has been adopted, based on the existing surface water standard for Walnut and Woman Creeks. This surface water standard was based on existing ambient levels of plutonium measured in these two streams, and therefore serves as a nondegradation standard that should prevent any increase in contamination. The site-specific plutonium ground water standard now adopted supercedes the statewide standard of 15 picocuries per liter, for ground water within this specified area.

It was also argued in this hearing that the Commission should adopt a health-based standard for plutonium, and that the appropriate health-based level is lower than 0.05 picocuries per liter. Based on the evidence submitted, the Commission has determined that it would be premature to set a different, health-based standard for plutonium at this time. Although some preliminary analysis has been done based on a 1×10^{-6} risk level, further internal and external peer review of the preliminary calculations needs to occur in order to determine an appropriate long-term, health-based standard.

Because the Basis Standards for Ground Water provide, at section 3.11.7 E, that the Commission will not consider changes in ground water standards more than once in any twelve month period, the Commission plans to hold a new rulemaking to reassess an appropriate plutonium standard in February, 1992. The Commission anticipates that the hearing will address radionuclide standards generally, for surface water and ground water, statewide and in the vicinity of Rocky Flats.

Specified Area

The specified area adopted by the Commission generally tracks the boundaries of the federal reservation on which the Rocky Flats Plant is located. All of the parties to this hearing indicated that they agreed with or were not opposed to this specified area.

Points of Compliance

The Commission has decided not to set any points of compliance for the water quality classifications and standards being adopted in this proceeding. A point of compliance would be established by whatever agency or agencies may have regulatory authority to implement these classifications and standards in the future. The Commission is not attempting in this proceeding to prejudge or second guess what agency or agencies that may be. If these classifications and standards are implemented by the Water Quality Control Division in accordance with its authority, points of compliance shall be established in accordance with its authority. In such circumstances, the Commission believes that points of compliance developed by the Division should at a minimum assure compliance with surface water classifications and standards established for the affected segments.

Although it appears from the evidence that potential exists for preventing Walnut and Woman Creek water from reaching the drinking water supplies in Standley Reservoir and Great Western Reservoir, the Commission's preceding direction to the Division concerning ground water points of compliance is currently appropriate. Until and unless the drinking water supplies are physically isolated, those reservoirs should be protected by strict standards. As the Commission similarly stated in the Statement of Basis and Purpose for the surface water standards in Woman and Walnut Creek, if in the future the cities' water supplies are adequately isolated, the Commission can reconsider at that time the appropriateness of both surface and ground water classifications and standards and its direction to the Division concerning points of compliance.

PARTIES TO THE
RULEMAKING HEARING
FEBRUARY 4, 1991

1. Department of Energy
2. EG&G Rocky Flats
3. City of Broomfield
4. City of Arvada
5. Jefferson Center Metropolitan District No. 1
6. City of Westminster

Table 7

STATE-WIDE STANDARDS

GROUNDWATER RADIOACTIVE MATERIALS

Parameter	Picocuries Per Liter
Cesium 134	80
Plutonium ^{38,} ^{239,} and ^{240}	15
Radium ^{226} and ^{228}	5
Strontium ^{90}	8
Thorium ^{230} and ^{232}	60
Tritium	20,000

Table 8

STATE-WIDE STANDARDS

GROUNDWATER CARCINOGENIC ORGANIC CHEMICALS [4]

Parameter	CAS No.	Standard [1] ug/l)	Detection Levels (ug/l) GC	GC/MS
Aldrin	309-00-2	0.002(I)	0.1	
Benzene	71-43-2	5		5
Benzidine	92-87-5	0.0002(I)		50
Carbon Tetrachloride	56-23-5	5		5
Chlordane	57-74-9	0.03(I)	0.1	
Chloroethyl Ether (BIS-2)	111-44-4	0.03(I)		10
DDT	50-29-3	0.1(I)	0.1	
Dichloroethane 1,2	107-06-2	5		5
Dichloropropane 1,2	78-87-5	0.56(L)		6
Dieldrin	60-57-1	0.002(I)	0.1	
Dioxin (2,3,7,8-TCDD)	1746-01-6	2.2 X 10 -7(L)		0.01[3] 3[5]
Diphenylhydrazine 1,2	122-66-7	0.05(I)		20
Ethylene Dibromide	106-93-4	0.0004(L)		10
Heptachlor	76-44-8	0.008(L)	0.1	
Heptachlor Epoxide	1024-57-3	0.004(L)	0.1	
Hexachlorobenzene	118-74-1	0.02(L)		10
Hexachlorocyclohexane (Lindane)	58-89-9	4	0.10	

Table 8 - Continued

STATE-WIDE STANDARDS

GROUNDWATER CARCINOGENIC ORGANIC CHEMICALS [4]

Parameter	CAS No.	Standard [1] (ug/l)	Detection Levels (ug/l) GC	GC/MS
Polychlorinated Biphenyls (PCBs)	1336-36-3	0.005(I)	0.5	
Toxaphene	8001-35-2	5	1.0	
Trichloroethylene	79-01-6	5		5
Trichlorophenol 2,4,6	88-06-2	2.0(I)		10
Trihalomethanes (total)		100		5
Vinyl Chloride	75-01-4	2		2

(1) Standards are based on the MCL for drinking water unless otherwise noted.
(2) Total trihalomethanes are considered the sum of the concentrations of bromodichloromethane (CAS NO. 75-27-4), dibromochloromethane (CAS NO. 124-48-1), tribromomethane (bromoform, CAS NO. 75-25-2) and trichloromethane (chloroform, CAS NO. 67-66-3).
(3) For permit issuance and compliance purposes use Test Methods for Evaluating Solid Wastes, Vol. 1B, EPA, November 1986, Method 8280.
(4) Organic chemicals not on this partial list are covered under section 3.11.5 (C) (1).
(5) For routine surveillance and screening using EPA Method 625

(I) Based on 10^{-6} Cancer risk from EPA Integrated Risk Information System.
(L) Based on EPA life time drinking water health advisory.

GC Gas Chromatography (Pesticides EPA-Method 508/608)
GC/MS Gas Chromatography / Mass Spectrometry (Methods 624 and 625)
CAS No. Chemical Abstracts Service identification number.

Table 9

STATE-WIDE STANDARDS

GROUNDWATER NON-CARCINOGENIC ORGANIC CHEMICALS (3)

Parameter	CAS No.	Standard (ug/l)	Detection Levels (ug/l) GC	GC/MS
Aldicarb	116-06-3	10 (L)	10 (2)(1)	
Carbofuran	1563-66-2	36 (L)		10
Chlorobenzene	108-90-7	300 (L)		10
Dichlorobenzene 1,2	95-50-1	620 (L)		10
Dichlorobenzene 1,3	541-73-1	620 (L)		10
Dichlorobenzene 1,4	106-46-7	75 (M)		10
Dichloroethylene 1,1	75-35-4	7 (M)		5
Dichloroethylene 1,2-Cis	156-59-2	70 (L)		5
Dichloroethylene 1,2-Trans	156-60-5	70 (L)		5
Dichlorophenol 2,4	120-83-2	21 (L)		10
Dichlorophenoxyacetic Acid (2,4-D)	94-75-7	100 (M)	0.1	
Endrin	72-20-8	0.2 (M)	0.1	
Ethylbenzene	100-41-4	680 (L)		5
Ethylene Glycol	107-21-1	7,000 (L)	5,000 (1)	
Hexachlorobutadiene	87-68-3	14 (I)		10
Hexachlorocyclopentadiene	77-47-4	49 (I)		10
Isophorone	78-59-1	1,050 (I)		10
Methoxychlor	72-43-5	100 (M)	0.1	
Nitrobenzene	98-95-3	3.5 (I)		10
Pentachlorobenzene	608-93-5	6 (I)		10

Table 9 - Continued

STATE-WIDE STANDARDS

GROUNDWATER NON-CARCINOGENIC ORGANIC CHEMICALS [3]

Parameter	CAS No.	Standard (ug/l)		Detection Levels (ug/l) GC	GC/MS
Pentachlorophenol	87-86-5	200	(L)		50
Tetrachlorobenzene 1,2,4,5	95-94-3	2	(I)		10
Tetrachloroethvlene	127-18-4	10	(L)		5
Toluene	108-88-3	2,420	(L)		5
Trichloroethane 1,1,1	71-55-6	200	(M)		5
Trichloroethane 1,1,2	79-00-5	28	(I)		5
Trichlorophenol 2,4,5	95-95-5	700	(I)		10
Trichlorophenoxypropionic Acid (2,4,5-TP)	93-72-1	10	(M)	0.05	

(1) PQL is based on Colorado Department of Health Laboratory's best professional judgment
(2) HPLC High Pressure Liquid Chromatography PQL (EPA Method 531.1)
(3) Organic chemicals not on this partial list are covered under section 3.11.5 (C) (1).
(M) Based on MCL for drinking water.
(L) Based on EPA life time drinking water health advisory.
(I) Based on reference dose from EPA Integrated Risk Information System (IRIS).

GC Gas Chromatography (Pesticides EPA-Method 508/608)
(Herbicides AWWA-Method 509 EPA-Method 515.1)
GC/MS Gas Chromatography / Mass Spectrometry (Methods 624 and 625)
CAS No. Chemical Abstracts Service identification number.

ROCKY FLATS PLANT	**Manual No**	**21000-MP-GPMP**
GROUNDWATER PROTECTION	**Procedure No.**	**Appendix E, Rev 0**
AND MONITORING PROGRAM PLAN	**Effective Date**	**2/15/92**
	Organization	**Environmental Management**

Comment Resolution Forms

Approved by J W Langman **Project Manager** 2/18/92 **Date**

Reviewed for Classification /UCNI

By. George H. Setlock

Date. 11/21/91 UNU

APPENDIX E

MARCIA S BRYANT

REVIEW/COMMENT RESOLUTION FORM

ROCKY FLATS ENVIRONMENTAL RESTORATION PROGRAM
REVIEW/COMMENT RESOLUTION FORM

Document No and Title Draft Final - Groundwater Protection and Monitoring Program Plan, June 13, 1991

Reviewer's Name(s) Marcia S Bryant

Date November 27, 1991

No.	Page No	Reviewer's Comment	Response
General			
1	1	Monitoring is covered fairly adequately, however, there needs to be a much more fully developed and descriptive *protection program*	Groundwater protection is the prevention, monitoring and remediation of groundwater at RFP Specific protection prevention activities to guard against spills and the infiltration and percolation of hazardous constituents down to the water table are addressed by plant procedures and the activities of the hazardous materials teams
2	1	Offsite water contamination is not addressed in this groundwater plan Monitoring needs to be fully extended to also include offsite sites that may be contaminated	Offsite groundwater monitoring in OU3 will be done by RFP Offsite domestic water well sampling should be done by CDH
3	1	The results of the RFP monitoring program need to be released to the public	Agreed RCRA groundwater monitoring data is reported in the Annual RCRA Report However, non-RCRA data is only reported once after a RI/RFI CERCLA investigation
4	1	We, the public want to get information and become informed so that we can make intelligent comments on the plans for the cleanup process at the Rocky Flats Plant	RFP supports your right to know and releases monitoring data at the Monthly Exchange meetings with the State
5	1	Please provide we, the public with a more comprehensive groundwater protection plan This part of your plan is very inadequate	The plan will be reviewed annually and updated every three years This will allow for constant improvement to all aspects of the groundwater program

APPENDIX E

CITY OF ARVADA

REVIEW/COMMENT RESOLUTION FORM

ROCKY FLATS ENVIRONMENTAL RESTORATION PROGRAM
REVIEW/COMMENT RESOLUTION FORM

Document No and Title Draft Final - Groundwater Protection and Monitoring Program Plan, June 13, 1991

Reviewer's Name(s) City of Arvada Date November 27, 1991

No	Page No	Reviewer's Comment	Response
General			
1		Rocky Flats should provide a list of acronyms used within the GPMP	A list of acronyms used in the document will be incorporated as an appendix
2		Rocky Flats should implement a program requiring all documents published for public distribution be copied on both sides of the paper	The GPMPP will be published on single-sided paper to maintain continuity of imbedded figures Additionally, as a working document, page-for-page replacements may occur as the document is updated It is RFP policy to recycle waste paper
3		A map depicting the boundary of the Rocky Flats Alluvium in relation to the Arapahoe Formation should be included in the document The boundary should identify those areas where the alluvium meets the ground surface	The contact between the Rocky Flats Alluvium and the Arapahoe Formation will be included on Plate 1
4		The Plan doesn't address sampling of any private off-site downgradient wells Rocky Flats should consider sampling of private wells in order to help establish off-site downgradient background groundwater quality levels of the area	The RFI/RI Work Plan for OU3 will be submitted according to the IAG schedule and will provide additional information for offsite well monitoring It is recommended that the CDH provide monitoring of private offsite downgradient wells not in the OU3 Program
Specific			
1	x	It is stated that at least $10 99 million is necessary in Fiscal Year 1991 to administer and implement the GPMP The Table at the bottom of the page does not correspond to the Fiscal Year 1991 $10 99 million figure Rocky Flats should explain the difference between the two dollar figures presented	The table should have stated Fiscal Year 1992 The table has been corrected
2	1-6	Paragraph two states that a release of non-waste materials or a one-time spill of waste does not qualify an area as an Individual Hazardous Substance Site (IHSS) Arvada requests that Rocky Flats include information on how these releases or spills will be defined if not as an IHSS	The identification of an IHSS was incorrectly stated The definition of an IHSS will be corrected and includes a release of a non-waste material or a one-time spill of waste

ROCKY FLATS ENVIRONMENTAL RESTORATION PROGRAM
REVIEW/COMMENT RESOLUTION FORM

Document No and Title Draft Final - Groundwater Protection and Monitoring Program Plan, June 13, 1991

Reviewer's Name(s) City of Arvada

Date November 27, 1991

No	Page No	Reviewer's Comment	Response
3	Table 1-3	The table provides information on the remediation and characterization related reports prepared under CERCLA and RCRA Upon review, we noticed that many of the reports carry the same names but are prepared at different times Rocky Flats should provide information on the differences in the plans and reports	Many documents prepared for the RFP are revised as conditions change or new information becomes available The earlier documents reflect conditions as they were known at that time As with all references the date should be used to distinguish between documents with the same name
4	Table 2-6	The table summarizes solar evaporation pond data above background upper tolerance levels for the second quarter of 1988-1989 Rocky Flats should provide similar data, if available, for OU-1 and OU-2 Additionally, information related to the applicable state standards for groundwater, or other relevant standards, should be included in Table 2-6 and other applicable Tables This will allow for easy comparison of sampling data to actual relevant standards	Water chemistry data are available for RCRA Interim Status units at RFP because the regulations require it OU1 and OU2 are CERCLA units with respect to groundwater monitoring requirements There are no reporting requirements under CERCLA correlative to RCRA Future plans to evaluate non-RCRA wells are recommended
5	2-72	Rocky Flats should provide a description of the water related studies which will be conducted for OU-2, OU-5 and OU-6 This description should acquaint the reader with the relationships between the studies and will help assure that if a particular study is not covered in one of the OU's, it will be covered in another	The IAG has established a schedule for the evaluation of each OU Work plans for OU-2, OU-5, and OU-6 will be prepared and submitted according to the IAG schedule
6	4-5	Section 4 2 2 states that there are no known plans for the development of large quantities of groundwater in the immediate vicinity of the Rocky Flats Plant This statement is not entirely correct The Jefferson Center development does have the ability to use groundwater within the development (See attached annexation agreement between the City of Arvada and Jefferson Center Associates, Section 5 8)	There are no known plans for the development of large quantities of groundwater in the immediate vicinity of the RFP Clarification of the annexation agreement has been included

ROCKY FLATS ENVIRONMENTAL RESTORATION PROGRAM
REVIEW/COMMENT RESOLUTION FORM

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Reviewer's Name(s) City of Arvada

Date November 27, 1991

No	Page No	Reviewer's Comment	Response
7	4-9	Paragraph one states that if, after consecutive quarters water is not detected in a well, it will be considered dry and it will become a candidate for abandonment Arvada's concern is that a well may be dry in "dry" quarters but may contain water in "wet" quarters A prolonged drought may also be cause for dry wells Thus, dryness in two consecutive quarters should not be the reason for abandonment, other factors could be impacting many wells during certain conditions	The SOP states that if after eight consecutive quarters water is not detected in a well, the well will be considered for abandonment The statement has been corrected
8	Table 4-4	The information presented in this Table is not comprehendible Revision should be made to the Table and a simple narrative describing what the Table is conveying	Text has been incorporated and the table, now Appendix C, has been altered to better convey information
9	4-25	In paragraph three, information is presented which states that a minimum of three well casing volumes will be purged prior to sample collection Rocky Flats should provide information in this paragraph which addresses what the sampling process will be for wells with low yields, i e , those that will not yield enough water to allow for three purges plus sampling	SOP GW 6 identifies purging procedures, however, because purging procedures are not policies, the statement has been removed from the text
10	4-26	The Quarterly Measurement of Groundwater Elevations section states that three hundred wells are measured for water level during the first week of each quarter The number of wells does not correspond to the 259 wells presented in Paragraph one on Page 4-9 Rocky Flats should detail what wells other than the 259, which are the core of the groundwater sampling program, are used to bring the total to 300	The text has been corrected to state that 259 wells are sampled every quarter at which time water level measurements are made

ROCKY FLATS ENVIRONMENTAL RESTORATION PROGRAM
REVIEW/COMMENT RESOLUTION FORM

Document No and Title Draft Final - Groundwater Protection and Monitoring Program Plan, June 13, 1991

Reviewer's Name(s) City of Arvada

Date November 27, 1991

No.	Page No	Reviewer's Comment	Response
11	5-3	Section 5 1 3 states that data from the groundwater program will be computerized as suggested by the Governor's Rocky Flats Scientific Panel on Monitoring Systems Rocky Flats should address whether the computerized data base system will be consistent with the new Colorado Department of Health computer database system The two systems should be identical or at least compatible in order to allow easy analysis of data from both sources in the same manner Additionally, data should be available to outside sources on floppy disks if requested	The RFP maintains the Rocky Flats Environmental Database System (RFEDS) for data from the groundwater program CDH is aware of this system and has access to the data The specific system used by the State is the decision of CDH
12	6-2	Information is presented in the Eliminating Duplicate Data section which states that a shortened analyte list will be established to monitor known contaminants in order to avoid sampling insignificant constituents at specific sites Rocky Flats should define how insignificant constituents will be determined Rocky Flats should also consider conducting a full scan of analytes every other year at wells located at the buffer zone boundaries even for constituents which are not expected This practice may go a long way in assuring the public of the quality of the water if it can be pointed that "<u>all these</u>" contaminates were not found rather than having only the option to indicate that "<u>these couple</u>" were found	Because of typically small water sample volumes, the analyte list is prioritized The prioritization considers the proximity of wells to more thoroughly analyze water quality The monitoring program may be expanded in the future to broaden the analyte list at specific intervals of time The specific analytes and their sampling frequency is currently being evaluated
13	Table 8-1	Reference is made under Direct Expanses section of the Table to the Wind Site Investigation Rocky Flats should clarify what this investigation is and why it is included in the GPMP	Text addressing the Wind Site Investigation has been added

APPENDIX E

CITY OF WESTMINSTER

REVIEW/COMMENT RESOLUTION FORM

ROCKY FLATS ENVIRONMENTAL RESTORATION PROGRAM
REVIEW/COMMENT RESOLUTION FORM

Document No and Title Draft Final - Groundwater Protection and Monitoring Program Plan, June 13, 1991

Reviewer's Name(s) City of Westminster Date November 27, 1991

No.	Page No.	Reviewer's Comment	Response
1	2-28	The Plan refers to the migration of dissolved solids and major ions downgradient of the 881 Hillside, and concludes there is no apparent impact on Woman Creek What studies have been performed which confirm 881 Hillside has not impacted water quality in Woman Creek? Future funding should be made available to determine the impacts of 881 Hillside, if any to Operable Unit 5, Woman Creek	Reference to "no apparent impact on Woman Creek " has been removed The impact OU1 (881 Hillside) has had on the environment is currently being investigated Reports generated from this investigation will be submitted according to the schedule presented in the IAG
2	2-45	The Plan indicates some wells may be influenced by other contaminant sources This may be the case in the Proposed Surface Water Interim Measures/Interim Remedial Action Plan and Decision Document for the 903 Pad, Mound, and East Trenches Areas which lists alluvial well #3986 as having carbon tetrachloride contamination of 2292 ug/L What studies or assessments address the possible sources of contamination in this well?	The impact OU2 (903 Pad, Mound, and Trenches) has had on the environment and specifically Well 38-86 is currently being investigated Reports generated from this investigation will be submitted according to the schedule presented in the IAG
3	4-9	The Plan states that not all groundwater monitoring must be done on a quarterly basis Information should be provided which identifies wells and parameters that actually are being sampled on a quarterly basis	Only RCRA wells are required to be sampled quarterly Boundary and Background wells are sampled quarterly by agreement with CDH and EPA Other wells are also sampled quarterly even though RFP is not obligated to do so Table 4-4 (now Appendix C) identifies those wells sampled quarterly Section 4 3 lists the constituents analyzed and the priority for analyses in the case of small volume samples
4	4-9	The fundamental policies of well sampling procedures should include recording water elevation and calibration notes on a monthly and quarterly basis	Water level measurements are made following the procedures in SOP GW 6 Water level measurements are taken each time the wells are sampled and monthly from a subset of 114 wells
5	4-26	States, "Procedures designed for the isolation and sample collection of free product contamination are not used " Does this indicate that a field blank or rinse blank will not be analyzed?	The statement has been removed from the text Free product (immiscible phases) are sampled per SOP GW 6 Groundwater Sampling
6		The Plan indicates that the nearest downstream domestic well should be sampled Have these wells been identified?	The work plan of the OU3 RFI/RI is being developed as per the IAG schedule The work plan will identify offsite wells which will be installed and monitored Downstream domestic wells should be sampled and assessed by CDH

ROCKY FLATS ENVIRONMENTAL RESTORATION PROGRAM
REVIEW/COMMENT RESOLUTION FORM

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Reviewer's Name(s) City of Westminster

Date November 27, 1991

No	Page No.	Reviewer's Comment	Response
7		The Plan's criteria for well abandonment is vague Complete criteria for the well abandonment and replacement program should be cited and explained in the Plan The Plan indicates a well which does not contain water after being monitored for consecutive quarters is considered dry and becomes a candidate for abandonment The Plan should include information on how many dry consecutive quarters are required prior to well abandonment The location and identification of the wells recommended for abandonment should be provided in the annual Rocky Flats Plant Site Environmental Report Consideration should be given to using non-approved wells, which do produce water, as piezometers	The Well Abandonment and Replacement Program (WARP) is cited in Section 4 4 If a well is dry for eight consecutive quarters, it becomes a candidate for abandonment The word "eight" was erroneously deleted from the text and has been corrected Wells that contain water but are not sampled are used as piezometers The term "non-approved" is not relevant to the groundwater monitoring program at RFP
8		The purpose, structure and differences between a background well and a monitoring well are not clearly defined Additional information would provide a better understanding of the placement of background and monitoring wells	Background wells are included in the monitoring program and are therefore considered monitoring wells More detail has been added to differentiate between background, boundary, RCRA, CERCLA, and characterization wells
9	4-27	The Plan states that changes in groundwater flow direction could warrant additional well installation The document should include the criteria for additional well installation What criteria or modeling is used to determine the location of new wells? For each well abandoned, is a new one installed in the appropriate location? What steps are taken to ensure wells are not placed in an area which would result in the spread of contamination into an otherwise uncontaminated aquifer? Westminster requests the opportunity to review locations for new wells prior to their construction Specifically, the West Spray Field is considered a potential source of groundwater contamination Additional wells in the vicinity of this location may provide better characterization of this site	New wells are added through the RFI/RI program in each OU and as needed in the Groundwater Program The WARP program allows for installation of up to 30 wells in the next 12 months These wells will be added after an assessment of the well program Background/upgradient wells are scheduled to be added downgradient of the gravel quarry operation west of the plant The cities do not have an opportunity to review well locations but can input their concerns while each work plan is in the draft stage prior to becoming final

APPENDIX E

COLORADO DEPARTMENT OF HEALTH

REVIEW/COMMENT RESOLUTION FORM

ROCKY FLATS ENVIRONMENTAL RESTORATION PROGRAM
REVIEW/COMMENT RESOLUTION FORM

Document No and Title Draft Final - Groundwater Protection and Monitoring Program Plan, June 13, 1991

Reviewer's Name(s) Colorado Department of Health

Date November 27, 1991

No.	Page No	Reviewer's Comment	Response
Specific			
1	v	The Groundwater Protection and Monitoring Program Plan for Rocky Flats should not be generated only to satisfy DOE Order 5400 1 The plant is currently under compliance order from the State of Colorado to develop and maintain such a plan for its identified RCRA units (CO 89-06-07-01), and thus this plan should also include specific information dealing with these previously identified areas The plan must also meet CERCLA standards and those set through the Interagency Agreement It cannot be assumed that DOE Order 5400 1 covers these areas unless they are actively correlated with these other enforcement actions and agreements	This document has been written to comply with 5400 1 and integrates and references appropriate regulations as well as documents and materials from the IAG
2	Figure 1-3	As presented, this map has no vertical or horizontal controls These should be provided with the map as either benchmarks or topographic lines in order to give the correct locations of the wells If there is a problem in providing this information, an explanation should be provided	Figure 1-3 presents relative locations of the well network at the RFP Areas of concern (i e , 881 Hillside, Solar Ponds) have been labeled for clarity Plate 1 provides topographic contours, and specific well numbers and provides state coordinates for horizontal and vertical control
3	2-1	Specific surface and bedrock geology maps are essential to any discussion of site geology and should be included Formation names should also be in the same order as their depositional sequence for better clarity	The formation names are provided in the same order as their depositional sequence A geologic map is being prepared as part of the surface geologic mapping of the Rocky Flats Plant and vicinity and is undergoing revision at present
4	Figure 2 1	Although informative, it is probably not needed in this report Descriptions of the other formations which underlie the Laramie-Fox Hills formations should also be deleted, unless the facility feels there is a need to include them	The stratigraphic section was provided for background information No discussion of the geology of RFP can be limited to the stratigraphic section on plant site The general geologic section and stratigraphic section must be included
5	2-6	The Arapahoe formation thickness is given as an absolute number (150 feet) Has this thickness been field verified?	The word "approximately" was added to the stated thickness It is an estimated value based on surface mapping and borehole information
6	2-6	The text on page 2-6 states that the Arapahoe Formation has at least five mappable sandstones, but Figure 2-3 states there are at least six mappable sandstones Which is correct?	The text is correct There are at least five mappable sandstone units The figure has been corrected

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7	2-7	Has it been conclusively proven that the "Arapahoe sandstone #1" is continuous? If so, where is the proof?	Arapahoe Sandstone No 1 has been mapped and is represented per the most recent core information as part of the conceptual geologic model for RFP High resolution reconnaissance seismic has been conducted in several areas of the plant Channels identified through this program are then drilled for confirmation
8	2-7	Discussion of the structural and stratigraphic variations, including fracturing, cementation, and depth of weathering, in the Arapahoe formation would be appropriate in this section	The stratigraphic variation is given in the formation descriptions The reference to structural variation is unclear as structure is covered in the text in Section 2 1 2 The occurrence of fracturing is currently under study Text has been added to address depth of weathering, while a discussion on cementation is beyond the scope of this document and is included in the Geologic Characterization delivered to CDH on September 25, 1991
9	2-7	The Rocky Flats Alluvium has, in past documents, been considered the primary formation in the uppermost aquifer A more detailed description of this unit would be appropriate	The description is more detailed in the Geological Characterization Report, which was delivered to CDH on September 25, 1991
10	2-7	There is no discussion on the composition of the colluvial deposits at the site Since these deposits are also a major part of the uppermost aquifer, they should be included in this discussion	A discussion of colluvial and valley fill materials has been added to the text
11	2-9	This section mentions the presence of a thrust fault located in the Pierre shale underneath the facility How and when was this fault detected? Is the facility certain that no motion has occurred along the fault in recent times?	This has been added to the text and a reference is made to the Geologic Characterization delivered to CDH on September 25, 1991
12	2-9	The discussion of structure and tectonics neglects the relationship of the Denver Basin to the monoclinal fold Figure 2-4 does not illustrate the angular unconformity between the Cretaceous strata and the Rocky Flats Alluvium which is important to an understanding of the hydrogeology The vertical exaggeration is not printed on this figure, which shows recharge areas discussed much later in the text One figure should not do double duty	The angular unconformity is clearly illustrated on Figure 2-4 Numerical values are not appropriate because they vary across the figure The ratio of the scale is correct

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13	2-9	Is this the depositional model that has been peer reviewed? It sounds like the Arapahoe basal conglomerate exposed near Golden has been assigned to the upper Laramie If so, what is the basis and reference for this decision? The evolution of the Arapahoe river channels from a braided system to a meandering system is a new aspect of the depositional theory previously presented This idea needs to be qualified and supporting references given Discuss what has been found by seismic work, locations or results of confirmation drilling, as well as future geologic characterization plans	Peer review by a neutral party is planned, but has not occurred at this time The text has been rewritten to bring it up to date with the Geologic Characterization No reference was made to suggest that the basal Arapahoe conglomerate, which outcrops near Golden, has been assigned to the upper Laramie The basal Arapahoe sandstone as originally mapped at RFP (now included in the upper Laramie Formation) was never interpreted to be correlative with the Arapahoe conglomerate at Golden For specific details the Geologic Characterization should be consulted The details of the high resolution seismic program, results of confirmation drilling, and future geologic characterization plans are beyond the scope of this document
14	2-7	Figure 2-7 shows an isopach of the Arapahoe sandstone #1 in the area, but the boundaries represented are, for the most part, approximate Has this channel been correlated through field studies, such as locating the contacts in the field through means other than drilling? If the channel does exist as shown, it should outcrop in several valleys and be easily correlated from that point	Arapahoe Sandstone No 1 has been mapped and is represented per the most recent core information as part of the conceptual geologic model for RFP High resolution reconnaissance seismic has been conducted in several areas of the plant Channels identified through this program are then drilled for confirmation Sandstone outcrops in drainages have been correlated
15	2-13	This section discusses the conceptual model of the site that has been verbally presented but never submitted and reviewed by either the State or the EPA Although the Draft Geologic Characterization Report on Rocky Flats Plant is not a required deliverable, it should be provided to back up the assertions made here Without this document, if cannot be assumed that the conceptual model is "currently accepted"	The Draft Final Geological Characterization Report was delivered to CDH September 25, 1991
16	2-13	The introduction to hydrogeology section needs a discussion of hydrogeologic units and a discussion of the upper and lower flow systems The discussion presented here tells what the hydrogeologic model is used for and is not a description of the conceptual model	This section has been rewritten in the text
17	2-15	A piezometric surface map should be included in this discussion The estimates of the infiltration rates or studies being done to determine them should also be included	A water elevation map has been added to the text as Figure 2-12 Infiltration studies are underway at OU1 and in the east Buffer Zone Both are subject to curtailment per funding levels in FY92

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18	2-15	No values are given for the colluvium on the site Since this deposit is fairly extensive and has had a high conductivity value assigned to it previously, it should be provided in this report	The hydraulic conductivity values for colluvium at RFP have not been validated at this time It is too early to state that they are high
19	2-15	Hydraulic conductivity in a single well is not representative of a system in which this parameter varies over several orders of magnitude The range and average values of each lithologic unit should be presented and the reasons for each variation should be discussed Secondary porosity effects, such as jointing, should also be included The difference between hydraulic conductivity and ground water velocity should also be included for clarity If there is a probable hydraulic connection between alluvial aquifers and Arapahoe sandstones 3, 4, and 5, it should be discussed in more detail Maps should also be included for these sandstones to show their location A discussion of what is known about ground water flow in the alluvial aquifers and flows to seeps and springs should also be included	Values of hydraulic conductivity represent only relative relationships for specific comparable lithologies and are not intended to be statistically valid There is limited evidence for fractures or jointing within the bedrock at RFP The presence of fractures is noted on core logs as part of ongoing geologic investigations The discussion of fracturing has been expanded in the text The explanation of hydraulic conductivity and effective velocity should not be given here Arapahoe Sandstones Nos 3, 4, and 5 are in the uppermost aquifer when they subcrop or crop out This is discussed further in the text A specific map of the Arapahoe Sandstones Nos 3, 4, and 5 is included in the Geologic Characterization A general discussion of groundwater flow is already presented in the text
20	2-16	Since the recharge area of the Laramie-Fox Hills aquifer out crops on the plant site, it cannot be automatically assumed that plant activities do not potentially affect this aquifer An in-depth discussion of this possibility may be warranted	The relationship of the plant's activities and the recharge area of the Laramie-Fox Hills aquifer are detailed in the text and Figure 2-5
21	2-18	The 1986 Part B Permit does provide log data for several of the pre-1986 wells Although these may not be as extensive or as accurate as later logs, they should still be examined for their usefulness Also, construction diagrams for some 1986 and 1987 wells show sumps located 6 to 12 inches below the screened interval	The intervals of 1/2 to 1 foot are not designed sumps, but represent the distance from the bottom of the screen to the base of the filter pack The pre-1986 wells are addressed further in the text
22	2-21	Several of the 259 wells currently designated for sampling are also damaged or show signs of subsidence What is in place to provide for the closure, and if necessary, replacement of these wells?	The well abandonment and replacement program exists to evaluate the condition and usefulness of wells The wells are either abandoned or replaced as necessary

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23	2-21	The range of hydraulic conductivity values is broad enough that significant contaminant transport has resulted in some areas, thus, the conclusion about yielding significant amounts of water is too general and inappropriate for this discussion The statement in this section about the lack of sampling on the 112 monitoring wells is contradicted in other areas of this document, and no reasons are provided on what type of damage has occurred to prevent their not being sampled Dry wells are not monitored, the definition of a dry well is also ambiguous (see Comment 51) A map is needed that shows which wells are monitored and which are not and the operable unit boundaries Figure 1-3 is not a large enough scale to include this information Information should be given on which wells are monitoring the same hydrogeologic unit	The text has been re-written to clarify the issue of significant yield All 259 wells are visited each quarter If a well is dry, it is not sampled The remaining 112 wells are either damaged, inaccessible, or have undocumented well constructions and are not routinely monitored Maps showing the operable units (OUs) are included in Appendix B Information on which wells monitor each hydrogeologic unit is too specific for this document and will have to be addressed in the future
24	Figure 2-8	Figure 2-8 shows the ground water plumes originating from the IHSSs How were these plumes determined, and from what data?	Areas of contaminated groundwater have been delineated through the monitoring program and through findings from RFI/RIs at OUs
25	2-28	In the section on the 881 Hillside, why were no 1990 data included? Since the date of this report is June 13, 1991, the majority of the 1990 data should have been included	This plan was first developed in June 1990 1988-1989 data were the most current at that time This document is to be reviewed annually and updated every three years When this report is updated, current data will be evaluated
26	2-31	Why was only one contaminant mapped in this area? Why are several figures presented with contaminant isopachs and other presented without them? What is the extent of contamination found in the Arapahoe Sandstone #1?	The most prevalent or extensive contaminant is mapped to indicate aerial extent The contaminant concentrations indicated on the maps have been revised to better indicate the extent of contamination The Arapahoe Sandstone #1 is not present at 881 Hillside
27	2-34	In the section on the Solar Evaporation Ponds, 1990 data is also omitted This is of concern, especially since the water quality data from this area showed a significant statistical increase in solvents in 1990 The 1990 data should be included in this report	This plan was first developed in June 1990 1988-1989 data were the most current at that time This document is to be reviewed annually and updated ever three years When this report is updated, current data will be evaluated
28	Figure 2-14	Figure 2-14 shows a large area assumed to be dry or unsaturated to the north of the Solar Evaporation Ponds This area has an extremely limited amount of data points and cannot be assumed to be dry or unsaturated unless it has been investigated Seeps have been reported previously in this area	The source of this data is the 1990 RCRA Annual Report Based on the data for the first quarter 1990, the area has been mapped as dry This does not mean the area is dry year round

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29	2-37	The original evaluation of the Solar Ponds states that solvents were put into the Original Solar Evaporation Ponds Since these solvents were, for the most part, "sinkers" (e g , trichloroethylene), it is possible that the underlying formations in the area have been contaminated Further investigation of the area needs to be done before it can be assumed that these formations are not contaminated	Evaluation of the analytical data in the RFEDS database, which is included in the RCRA annual reports should define the extent of contamination Sandstones below the uppermost aquifer are monitored to characterize the groundwater on the regular basis
30	2-37	Which wells in the designated confined system have lower values of nitrate, total dissolved uranium, and tritium? Where are they located? Are they within the area of influence from the ponds?	Details such as these should be addressed in the individual OU reports and the RCRA annual reports
31	2-37	Ground water migrates to the north and northwest of the Solar Evaporation Ponds because of the tributary to Walnut Creek located just north of the site The plume delineated in the map, as well as future studies, should consider the effect this drainage has on the site	Agreed The effects of the drainage will be considered in all documents
32	2-45	Although the 1989 results do not appear to indicate any contamination from the Solar Evaporation Ponds, there is still the possibility that the original ponds may be contributing to the contamination problems detected in the 1990 data Again, the 1990 data should have been included in this report for comparison, as several of the conclusions drawn here may have changed with that information	This plan was first developed in June 1990 1988-1989 data were the most current at that time This document is to be reviewed annually and updated ever three years When this report is updated, current data will be evaluated
33	2-47	Previous reports on the Present Landfill area have described a contact between outcrops of the Arapahoe sandstone and the fill areas Has this been taken into consideration? Also, the potentiometric data from wells in the IHSS show that there is cross-gradient flow into and out of the unit seasonally Has this also been taken into consideration?	Details such as these should be addressed in the individual reports and the RCRA annual reports
34	2-54	Since there is only one bedrock well within the West Spray Field area, it cannot be conclusively stated that the bedrock water quality has not been affected Although the spray operations were conducted on a localized basis, if is still possible that contamination may be present in the area just above the bedrock.	Based on that single well, bedrock water has not been degraded Additional wells were installed in 1989 Data from these wells will be available in future RCRA annual reports
35	2-61	It is not clear whether Arapahoe Sandstones 1-5 are specifically or generally included in the water storage calculation	Sandstones Nos 1-5 have been included in water storage calculations This has been clarified in the text

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36	2-62	Comparison of ground water in storage with surface water storage capacity may be misleading The time frame of surface water storage is different from the time frame of ground water storage, so a comparison of volumes is inappropriate until infiltration rates are quantified There are ground water mounds under all the unlined storage ponds on site Storage in the Laramie-Fox Hills aquifer should not be included unless significant interaction with surface water is shown	The comparison of quantities of surface water in storage at RFP to quantities of groundwater in storage beneath RFP has been removed on pages 2-61 and 2-75 Because the Laramie-Fox Hills aquifer crops out in the west Buffer Zone at RFP, there is an interconnection of this aquifer with surface water including recharge from precipitation, recharge from the ditches crossing the outcrop, and recharge from streams crossing the outcrop
37	2-68	Pond water from the Present Landfill pond is currently sprayed on the southern bank of the pond and not over the pond itself	The text has been modified to describe the current situation
38	2-68	The year of each of these regulations should be included in the regulatory cites, as changes to the regulations can affect what rules actually apply	A conventional method of reference to the citations was used This does not include the year of promulgation
39	3-10	Under 265 90 (d)(1) of 6 CCR 1007-3 (Fall, 1990), the facility has not submitted an adequate plan to comply with the regulatory requirements of an alternate ground water quality monitoring system The September 1989 Ground Water Assessment Plan and May 1990 Ground Water Assessment Plan Addendum provide only minimal information as to what monitoring will be done Although these plans are currently in use, there is still a requirement for Rocky Flats to provide an adequate plan with updates as necessary to determine what will be done to monitor these areas	The text of Section 3 2 2 has been modified to specifically reference the two documents identified in the CDH comment Upcoming actions by EG&G are also referenced In September of 1991, CDH transmitted comments to RFP concerning the May 1990 Groundwater Assessment Plan Addendum These comments are currently being addressed Reference to the Plan and Addendum has already been made on Page 3-7, (now 3-8)
40	3-12	In Colorado, the Department of Health is the agency which specifies the points of compliance in RCRA-regulated units	Text has been added that states the point of compliance is set by the local regulatory agency
41	3-13	There are currently no detection monitoring programs in force at any of the RCRA units currently identified at the Rock Flats Plant	Agreed The information was provided as another type of program
42	3-15	Table 3-1 should list the original sources of the concentrations for the constituents listed Some of these items have changed in lieu of implementation of the TC rule and also the Colorado Water Quality Control Commission standards issued prior to this document's release Site specific standards for the facility include cyanide (free), fluoride, and nitrite in "Table 1 - Human Health Standards"	Table 3-1 has been updated Table 3-1 has been changed to list the original source of the constituent concentrations Table 3-1 of the GPMPP presents standards specified in 6 CCR 1007-3, 264 94(a)(2) Until such time as 6 CCR 264 94(a)(2) Table 1 is officially changed, Table 3-1 is correct

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43	3-16	Corrections to proposed ground water concentration limits in Table 3-2 are **Constituent (mg/l)** / **Standard** / **Source (Site-specific stds)** Ag++ / 0 05 / Table 1 Be+ / 0 1 / Table 3 Co+ / 0 05 / Table 3 Cu+ / 0 2 / Table 3 Hg++ / 0 002 / Table 1 Li+ / 2 5 / Table 3 Mn / 0 05 / Table 2 Ni+ / 0 2 / Table 3 V+ / 0 1 / Table 3 Zn+ / 2 0 / Table 3 Cl / 250 / Table 2 SO4 / 250 / Table 2	Table 3-2 identifies maximum concentrations of constituents for groundwater protection presented in an EG&G groundwater document Until that document is modified, this table is still accurate However, in order to address the recent Water Quality Control Commission site-specific standards, additional discussion will be included in the text and an additional table presenting the site-specific standards will be presented
44	3-17	The Colorado Water Quality Control Commission standard for Strontium-90 is 8 pCi/l	A state-wide standard for strontium of 8 pCi/l has been established by the WQCC However, there remain unresolved issues as to whether these state-wide WQCC standards are legally enforceable and/or of general applicability
45	3-28	There should be no downstream domestic water wells for plutonium	The text has been corrected The text was incorrect as presented It should have said that downstream domestic water wells should be sampled and analyzed for plutonium The text has been modified to reflect RFP's feeling that the offsite domestic water wells should be sampled for appropriate constituents by CDH
46	Table 4-1	Table 4-1 should be dated Names of personnel who work for Jim Langman would also be helpful	The table has been updated Names of personnel change too frequently to be included here
47	4-1	The State and the EPA should be provided pertinent information when changes are made to the ground water quality monitoring program This is a requirement under 6 CCR 265 94, as well as 40 CFR 265 94 If possible, the facility would provide a regular report to both agencies concerning this issue	The State and EPA are provided pertinent information when changes are made to the groundwater monitoring program

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48	4-5	There are approximately 28 wells with domestic use listed in the State Engineers database within a mile east of Indiana Street, the State is not aware of how many have been abandoned Three industrial or commercial wells are listed within a mile of the plant boundary Since these wells are present, it cannot be assumed that ground water near the plant is used in limited quantities or that no large quantities of water will be used from this area in the future If previous demographic studies made by the facility support these statement, they should be documented and made available	The discussion in the GPMPP has been modified to better address current and planned future uses of groundwater in the area near RFP
49	4-7	The facility has agreed to provide both the State and EPA with a quarterly update in electronic format (DBASE, LOTUS, or ASCII) with standardized qualifier information This commitment needs to be formalized and continued	The desire to formalize these tasks should be directed to the proper organization and is beyond the scope of this document
50	4-7	This document stated previously that only 259 wells were routinely monitored, but here it states that 371 wells are piezometers are monitored Which is correct?	The groundwater monitoring program consists of 371 wells and piezometers of which 259 are routinely monitored
51	4-9	There are several definitions of what constitutes a "dry well" in regard to sampling Which one is to be considered in effect -- the one provided in this document, or the one given in the 1991 Standard Operating Procedures? Also, how many consecutive quarters are to pass before the well is considered a candidate for abandonment? What consideration is given to climatic or hydrologic changes that may have taken place? Will the well's construction be checked prior to the abandonment decision? Since, for the most part, abandonment of wells will cause a change to the ground water monitoring plan, the State and the EPA should be notified of the change well in advance The change may also necessitate approval from the State or EPA, as required under 6 CCR 265 90 through 94 (40 CFR 265 90 - 94)	The definition of a dry well as described in SOP GW 6 is correct The reference to "dry well" in the text was used to describe a well that could not be sampled for 8 consecutive quarters and that should be considered for abandonment The text has been corrected to reflect that after eight consecutive dry quarters the well will be considered a candidate for abandonment No consideration is given to climate All wells considered for abandonment will be approved by CDH and EPA

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52	4-32	See note for section 2 2 2 on range of hydraulic conductivity Direct quote from Fetter 1988 "Hydrostratigraphic units are comprised of geologic units grouped together on the basis of similar hydraulic conductivity Several geologic formations may be grouped into a single aquifer, for example A single geologic formation may be divided into both aquifers and confining units " The author of this section seems to be looking for a word to differentiate the confined Arapahoe sandstones on the basis of their low hydraulic conductivity While the lower Arapahoe sandstones are indeed a hydrostratigraphic unit it is incorrect to use the term of differentiate them from an aquifer Fetter defines an aquitard as "a layer of low permeability than can store ground water and also transmit it slowly from one aquifer to another " Classification of ground water in the State of Colorado is based on this definition from "The Basic Standards for Ground Water" 'Ground Water' are subsurface waters in a zone of saturation which are or can be brought to the surface of the ground or to surface waters through wells, springs, seeps or other discharge areas " This definition is broad enough to include most water in the Arapahoe formation whether it is in the subcropping sandstones, the confined sandstones, or the claystone	Fetter also describes an aquifer as "Rock or sediment in a formation, group of formations, or part of a formation which is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs " By this definition none of the formations at RFP is an aquifer Is the State setting a precedent by defining aquifers on the basis of the Fetter and other textbook definitions?
53	4-36	The State does not have information on hydraulic conductivity tests for <u>all</u> completed wells	Tests were not performed on all wells The text has been modified to reflect this
54	4-42	Has a new landfill site been selected, and, if so, has it been approved?	Site No 1 west of the Present Landfill has been selected, but has not been approved at this time
55	4-43	Section should be relabeled as Section 4 5 More in-depth discussion, as well as appropriate references, should be given here	Text has been modified
56	9-4	A complete reference should be given for Robert Moran's 1990 report	This reference has been deleted

APPENDIX E

ENVIRONMENTAL PROTECTION AGENCY

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1	v	The plan is to be used as a tool for the monitoring and protection of groundwater Therefore it follows that the plan should be kept current and updated as processes change and not on a three year basis	The groundwater program is kept current as processes change and new information is obtained The plan is reviewed annually and updated every three years to reflect changes in the program
2	vi	The Interagency Agreement is also a driving force in groundwater monitoring at Rocky Flats	The IAG mandates compliance with RCRA, Colorado Hazardous Waste, and CERCLA regulations, as well as other agency standards, which are driving forces of groundwater monitoring at RFP Section 3 2 8 has been added to provide more information about the IAG
3	ix	The acronym RFEDS must be defined Changes in monitoring plans that will impact IAG workplans must be approved by EPA prior to changes (i e analyte lists and wells sampled)	RFEDS is defined in two paragraphs prior to its use here It is understood that changes in monitoring plans that will impact OU workplans must be approved by the lead regulatory agency
4	x	The document needs to address the budget for fiscal year 1992 (It is not clear if there is a typographical error and that the 1991 should be replaced by 1992)	The typographical error has been corrected
5	1-5	The statement that a release of a non-waste material or a one-time spill of waste does not qualify an area as an IHSS is incorrect The word **does** needs to be replaced with the word **may**	The identification of IHSS was incorrectly stated A release of non-waste material or a one-time spill of waste may qualify an area as an IHSS
6	1-18	The Agreement in Principal between DOE and the State of Colorado also requires ground-water monitoring	A statement was added that the AIP requires groundwater monitoring This section was moved to Section 3 2 8
7	Figure 1-3	Major features of the map need to be labeled	The purpose of Figure 1-3 is to show relative placement of wells Major features of the plant are indicated on Plate 1
8	Table 2-1 Page 2-4	In some locations, the bedrock crops out and the Rocky Flats Alluvium would not be present	Agreed Table 2-1 refers to areas where the Rocky Flats Alluvium is present It actually is less than 10 feet in some areas where construction activities have removed portions of the alluvium

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9	2-1 and 2-3	The stratigraphic sequence underlying the Rocky Flats Plant may not be a continuous transition from a marine to fluvial environment The report should reference that the stratigraphic model is under investigation and will be better determined with information gathered from the geophysical studies and incorporation of core data from the environmental restoration drilling programs Figure 2-2 shows the basal Arapahoe Formation as a unit higher in the idealized fluvial system According to the text, the basal Arapahoe should have formed immediately behind the delta and not behind the upper Arapahoe Formation	Text has been added to state that the stratigraphic model is being investigated and will be evaluated with additional data produced from current and future studies The figure has been corrected to conform with the text
10	2-7	Faults in the area were activated as a result of underground injection of Rocky Mountain Arsenal waste in the 1960s The report should mention the impact this had on the study area The thrust fault in figure 2-6 should be discussed in the text	Faults were activated near the arsenal by injecting fluids into deep bedrock intervals The faults in the Rocky Flats area were not activated by the activities at the arsenal Additional text has been added to describe the thrust fault shown in Figure 2-6, (now Figure 2-7)
11	Figure 2-7	Figure 2-7 represents an idealized model for deposition of sandstone unit no 1 as determined from core and well logs This interpretation is subject to change as more information is gained and the text should state the status of the interpretation	Text has been added to emphasize the stratigraphic model is interpretive A second interpretation has also been provided
12	2-15 and 2-16	A well location map should be provided for the wells mentioned in the text It appears that well number 00-89 is a typo An explanation is necessary regarding the source of the hydraulic conductivities (i e averaged values or site specific)	The well location has been corrected to read 1-89 However, well 00-89 does exist, and is shown on Plate 1 and listed in Appendix C The hydraulic conductivities were calculated from test data for the stated wells They are listed solely for comparison
13	Section 2 3 2	A discussion of the hydraulic interconnection between the Rocky Flats Alluvium and the underlying Arapahoe Claystone is necessary	The text has been changed to describe this relationship
14	Section 2 3 2	The plan should discuss the significance of the Background Geochemical Characterization Report for determining changes in the concentrations of analytical parameters	The text has been changed to describe the Background Geochemical Characterization Report and how the results from the report are used
15	Section 2 3 2	Sampling and analysis is completed to determine the vertical extent of contamination as well as the horizontal extent The text should be modified to include this	Text has been added to clarify the evaluations of vertical as well as horizontal extents of contamination
16	Figure 2-8	The figure should be labeled to recognize that not all plumes may be identified at this time	The figure has been updated and text has been added

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17	Figure 2-8	The plume in the 881 Hillside (OU 1) must be added to the figure	The figure has been updated
18	2-28	The text must explain that as a result of the RFI/RI process as outlined in the IAG, the nature and extent of contamination will be determined It is not appropriate to state in the plan that the contamination is confined to the IHSS	This statement has been added
19	2-31	The term unconfined groundwater is used in this section This should be defined earlier in the text for general public understanding	The term was changed to "alluvial" groundwater which is clearer and has been used throughout the document
20	2-31	The plan must reflect that more information will be gathered during the phase III RFI/RI investigation for OU 1 before a level of certainty can be placed on the vertical extent of contamination (i e contamination of groundwater in the bedrock)	The text has been modified to reflect the study is ongoing, and more information will be gathered
21	Figure 2-12	Connection of isopleths around different IHSSs may be misleading depending on the amount of information that is known between different IHSSs	The figure has been updated with new information
22	2-38	In Table 2-6, the key identifying the geologic units should include SPC	SPC has been dropped from the table
23	2-37	The Background Geochemical Characterization Report should be referenced as the source for the background upper tolerance levels	The source for the background tolerance levels is given on page 2-34 This information will also be added to Table 2-6
24	Table 2-9	In Table 2-9, it is not clear how the average thicknesses were determined for the different geologic units The average thickness for the sandstone and siltstones is not consistent with those provided earlier in the text The basis for not calculating water stored in the Arapahoe claystone is not justified This could provide useful information	Because on-site data for the Arapahoe Formation, and deeper geologic units beneath RFP, are not generally available, the average thicknesses and saturated thicknesses of these geologic units were taken from Colorado State Engineer publications These values agree quite well with the composite sandstone thickness present on average at RFP
25	Table 2-11	A typo is present in footnote 2	The typographical error was corrected
26	Section 2 3 4	An explanation of the current water diversion structures is necessary Water transfer from Smart 2 Ditch should be checked for accuracy	The transfer of water from the irrigation database has been reviewed Corrections were made on Figure 2-19, (now Figure 2-24)

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27	2-68	The plan must also coordinate with the IAG activities *It appears that a heading is missing on page 2-69*	The discussion of this Surface Water Management Plan and its relationship to the IAG should be addressed in the Surface Water Management Plan and is beyond the scope of this document The text was altered to correct the missing heading
28	2-71	This section needs to be updated regarding the IM/IRA and RFI/RI for the pond area remediation	Reference has been made to the IM/IRA and RFI/RI
29	2-72	The OU 2 IM/IRAs should be discussed	The draft IRAP for OU 2 is discussed
30	2-73	The text needs to be updated with the current pond water treatment activities	The text has been updated with current pond water treatment activities
31	2-75	The text refers the reader to Table 2-9 to compare water storage in surface impoundments to that in the geologic units However, the units for each are different and not directly comparable	Units are now presented so the text and table are comparable
32	Section 3 1	An additional requirement is to determine the presence of trends in groundwater contaminant movement	This additional requirement has been added to the list
33	3-5	RCRA requires that new hazardous waste treatment storage or disposal facilities be permitted prior to use Interim status was granted to facilities in existence prior to RCRA upon submittal and approval by the regulatory agency of the Part A application The interim status facilities are to be either retrofitted to meet RCRA regulations or closed under interim status by predetermined dates This must be clarified in the text	The text was modified to be more clear on interim status facilities The comment was largely correct as presented, but over-simplifies the RCRA interim status issues at Rocky Flats due to issues regarding mixed hazardous and radioactive materials The text of this section has been modified to more fully address interim status issues, particularly as these issues apply to groundwater
34	3-5	A RCRA land disposal unit which is not cleaned closed will require post closure care which includes groundwater monitoring The length of the post closure care period is up to 30 years or as required by the regulatory agency	This is stated in the text The regulatory requirement for post-closure groundwater monitoring at all non-clean closed RCRA land disposal units was discussed The text has been modified to better address post-closure groundwater monitoring requirements
35	3-6	Exemption requests from RCRA groundwater monitoring requirements must also demonstrate that there is no harm to human health and the environment	The statement has been added to the text

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36	3-10	The second paragraph must include submittal of notice to the CDH Director	Text has been added to reflect this
37	3-19	This section of the text should refer to the IAG for a more detailed outline of how this process will take place at the Rocky Flats Plant	Text has been added to clarify the IAG processes
38	3-21	The acronym OU should be spelled out	The acronym has been spelled out and also appears in the acronym list
39	3-22	The agreement that sets requirements for the STP is not the FFCA signed on January 22, 1991 The correct agreement must be stated in the text	The NPDES FFCA signed March 25, 1991 sets the requirements for the STP
40	3-23	The process for choosing clean up methods for OUs is directed under the IAG and not NEPA The IAG defines the cleanup process via CERCLA and RCRA regulations	The methods follow the nine criteria for CERCLA but NEPA looks further into cumulative impacts, socioeconomic, etc NEPA provides a more complete disclosure of the facts pertaining to environmental concerns
41	3-28	The data needed to determine remedial alternatives is compiled under the IAG process and not the NEPA process There are no "trade-offs" between the No-Action alternative and other remedies The remedy decision is based on the nine criteria identified under the CERCLA process EPA will not inhibit DOE from carrying out the NEPA policy However, the decisions made for remedial activities are predicated by the IAG This section of the text must be rewritten for clarification on this point	The statement describes the NEPA needs for data to make the proper assessment of the environmental activities It does not reflect interactions among agencies
42	4-8	The parameters for analysis for monitoring wells in OUs are provided in the workplans for the OUs These workplans are approved by CDH and EPA	The text has been modified to include this comment
43	4-9	SOPs 2 6, 2 1 and 2 2 should be replaced with the revised SOP identification numbers The sample procedures outlined in this section must be consistent with the SOPs approved by CDH and EPA	SOP references have been updated to reflect the September 30, 1991 Rocky Flats Plant Environmental Management SOPs
44		The procedures for sample collection of free product contamination are provided in the SOPs If an area of contamination has free product contamination, the contamination must be sampled for site characterization under the IAG	Agreed Text describing this has been added to the list

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45	Table 4-4	The text and table 4-4 do not provide an explanation for the sample frequency and water level measurement frequency for the specific wells not sampled and measured on a quarterly basis The text needs to supply more detail to understand the rationale behind the sampling and frequency measurements	Table 4-4 has been removed from the document text and included as Appendix C Text describing the content of the appendix has been added to detail the 5 well classifications The reasons wells are not sampled are addressed in Section 4 4 on WARP, Well Abandonment and Replacement Program The sampling frequency and analytes are currently being investigated to reduce sampling costs at RFP
46	4-31	EPA and CDH approved the QAPP in June, 1991	The text has been updated to reflect this
47	4-32	The definition of an aquifer is not based entirely on hydraulic conductivities Therefore, the Arapahoe Formation including the subcropping sandstones are considered as part of the uppermost aquifer It is premature to conclude that the Arapahoe Sandstones No 3, 4 and 5 are not significantly water bearing	This section was included to raise the technical issue of what is or is not an aquifer It is clear that further discussions and additional data are needed to resolve this issue
48		The handling of outliers in the data base and statistical methods used must follow those approved by EPA in the Background Geochemical Characterization Report	The statement has been added to the text
49	4-34	The text needs to provide in what form (i e IAG reports) the aquifer test information and vadose zone characterization will be presented	Test results from wells and boreholes from OU/IAG activities will be reported in documents scheduled in this IAG The results from site-wide wells and borings will be reported in future phases of the Geologic Characterization and un-named reports The vadose zone characterization will be reported per FFCA and EPA requirements
50	6-1	Validation and verification of all data in RFEDS must be completed in a timely manner Currently, all data has not been checked This has a substantial impact on the IAG and RCRA compliance projects	Agreed Validation and verification is in progress
51	6-1	This section needs to discuss how these improvements will be implemented	The methods and procedures needed to implement these improvements are being gradually instituted Because of the nature of the activities it will take several months Specific details can not be presented at this time
52	6-2	Data from wells providing information for the IAG must not be eliminated without EPA approval of a change in the OU workplans	The statement was added for clarification
53	6-3	The plan needs to specifically outline how and by whom groundwater monitoring compliance audits will be performed	No specific procedure is in place that describes how audits will be performed This issue should be addressed by CDH and DOE in the near future

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54	7-1	It is premature to state that contamination in certain localities (i e under buildings) will remain in place Selection of remedial actions are determined through the CERCLA process	Contamination beneath a building will remain in place until the building is closed The text has been edited to clarify this The discussion presented was not intended to imply that contamination would remain in place indefinitely Remedial actions to address contamination identified under buildings will be determined through negotiations with the agencies in authority and through the CERCLA process
55	8-7	The report needs to explain how the community will be kept abreast of the groundwater protection monitoring program (i e through the Community Relations Plan under the IAG or other)	Text has been added to detail how the community will be informed of the monitoring program

APPENDIX E

ROCKY FLATS CLEANUP COMMISSION

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General		The title of this document is the Groundwater Protection and Monitoring Program Plan After careful review, the Rocky Flats Cleanup Commission finds that the monitoring and data analysis aspects are adequately covered, but the protection program is woefully undeveloped We are left with the impression that the authors view monitoring as the most significant contribution towards protection The Cleanup Commission views this as a policy of reaction rather than a concerned professional, proactive response which exhibits concerns for the environment and the community A monitoring program acts as a sentry to detect approaching contamination but it does not <u>protect</u> the groundwater from <u>becoming</u> contaminated	Groundwater protection is the prevention, monitoring, and remediation of groundwater at the RFP Emphasis is on monitoring because it is a *Monitoring Plan* as well as a *Protection Plan*
1		We recommend that forthcoming plans describe in better detail what actions might be necessary to truly protect groundwater that is currently uncontaminated from becoming contaminated For example, you might explore the possibility of dewatering the ground as a deterrent to groundwater contamination The <u>*Surface Water Management Plan*</u> released earlier this year mentions in Table VII-16 a variety of "tasks" that are included in a zero discharge evaluation for RFP One of the tasks mentioned is #26, listed as a study for the "feasibility of groundwater cutoff/diversion " Interestingly, the protection concept of zero discharge is not even mentioned in this groundwater plan This lack of discussion of protection programs is a glaring defect and definitely should be corrected in future plans	This is a protection and monitoring plan Dewatering activities would be included in an RI/FS Treatability Study specific to an OU The zero-offsite water-discharge study is in the preliminary evaluation stage and conclusions and recommendations have not yet been made These studies have been mentioned several times in the GPMPP
2		This groundwater plan does not address offsite contamination The only offsite activity discussed is the testing of the nearest offsite well for plutonium contamination The Cleanup Commission would recommend that characterization studies and full monitoring activities be extended to include offsite areas or that explanation be given as for their lack of inclusion	The RFP does not have the authority to sample offsite other than what is included in OU3 The IAG has a schedule for investigating OU3 It is recommended that CDH provide monitoring of private offsite downgradient wells not in the OU3 program

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3		No mention is made of bedrock fracture data or related studies The <u>Responsiveness Summary for the Surface Water IM/IRA Plan and Decision Document for South Walnut Creek Basin</u> mentions on page 2-67 that the studies are necessary and ongoing We are concerned that these fractures have the potential to transmit groundwater at velocities greater than either the alluvium or bedrock This Groundwater Plan should address this issue	The existence of fractures in alluvium and bedrock will be addressed on an OU-specific basis The presence of fractures is noted on all logs Fractures in the alluvium was mentioned in the Geotechnical Report for the french drain at OU1 and their influence on hydrology is being studied as specified in the OU1 Phase III RFI/RI Work Plan
4		More discussion is necessary concerning the methodology for taking groundwater samples Is the plant screening the well casing for the entire depth of the aquifer under study? Our major concern is for floaters and sinkers that may escape detection	Groundwater samples are taken as directed in SOP GW 06 Wells are installed as directed in SOP GW 06 The detection of floater and sinkers is also a concern of the scientists and engineers involved with the monitoring program at RFP The wells are screened in a manner that will detect these forms of contaminants
5		Even through Figure 2-4 shows it correctly, several discussions in the text state that the Rocky Flats alluvium is recharged offsite, west of the plant, where Cretaceous and older units have been tilted eastward by uplift and eastward thrusting of the Precambrian crystalline terrain This would imply that groundwater in the uppermost aquifer, upon entering the area below the plant site, would be clean except for natural contamination or offsite anthropogenic contamination This is not true The alluvium is also recharged <u>from above</u>, albeit slowly This includes overland flow, and would include rainwater falling on or flowing over contaminated sites above the alluvium	Recharge to the Rocky Flats Alluvium occurs from both onsite and offsite Areas where contamination occurs is being investigated onsite and offsite The text does describe recharge from precipitation events
6		Given that the natural range of hydraulic conductivities for silty sands is about 10^{1} to 10^{-5} cm/sec (see Freeze and Cherry), hydraulic conductivities around 10^{-5} for channel sandstones in the Arapahoe formation and the Rocky Flats Alluvium seem curiously low Given that the contamination plumes near the plant site have spread as far as they have from the actual spill/dump sites, one would suspect higher conductivities in these units These conductivity measurements need to be reexamined	Freeze and Cherry present a range of hydraulic conductivities for typical silty sands and are not specific to local geologic conditions Geotechnical analyses have been performed on samples of the Arapahoe Sandstone and Rocky Flats Alluvium and the hydraulic conductivities are empirical These values fall within the range presented by Freeze and Cherry Geochemical modeling has indicated nothing unexpected in contaminant migration using empirical hydraulic conductivities than what water quality data have shown

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Specific			
1	viii	The list of activities included in the RFP monitoring program also should include some sort of program for reporting to the public An arrangement should be made to have groundwater monitoring data discussed at the monthly Exchange of Information Meeting with a wrap-up made to the general public at the monthly meeting to the Rocky Flats Environmental Monitoring Council	Groundwater samples are collected quarterly and summarized in Annual Reports for RCRA Regulated Wells CDH receives data from non-RCRA regulated wells although there is no requirement for presenting these in an annual report Data for CERCLA characterization wells are reported in documents which are listed in the IAG
2	1-5	The second sentence in the first paragraph reads, " some activities have resulted in the <u>potential for</u> environmental contamination of portions of RFP " The words "potential for" should be stricken	The words "potential for" have been removed
3	1-6	Paragraph 2 - One-time spills How will one-time spills, which presently are not regulated, be handled? Will they be handled under this document? Is there any specification for the amount of spillage that must occur before the spill becomes regulated and therefore cleaned up? Is a listing of these spills available?	One-time spills will be considered IHSSs and will be regulated as outlined in the IAG This has been clarified in the text
4	2-5	Figure 2-3 The description of the Arapahoe Formation lists "at least <u>six</u>" mappable sandstone units However, page 2-6 says <u>five</u>	The statement should have read " five mappable units " It has been corrected
5	2-7 and else-where	Location of the sandstone channels in Arapahoe Several parts of the plan indicated that because the hydraulic conductivities of the lower sandstone aquifers are low, therefore these units are of little to no concern This seems to be short-sighted thinking The locations of the channel sandstones in the Arapahoe Formation have not been defined There is no reason to believe that water demand from these aquifers will ever be less than it is today, and , in fact, it is likely to go up To ignore these units in the overall GW Management Plan is to ignore possible drinking water of future generations These units should be managed, and should not be opened up for contamination	RFP is very concerned that the hydrogeology and potential migration pathways are identified This is the reason for the extensive geologic characterization efforts at the plant It is only through these efforts that the nature and extent of the sandstones have been determined By accepted definitions from Freeze and Cherry and others, the Rocky Flats Alluvium and the Arapahoe Sandstones at RFP are not aquifers Both of these formations have hydraulic conductivities below 10^{-4} cm/sec The groundwater contained in the Rocky Flats Alluvium and the Arapahoe Formation at RFP is only monitored, not produced Finally the sandstones containing contamination in the Arapahoe Formation at RFP are not continuous with the Arapahoe aquifer in the Denver Basin
6	2-28	The narrative discussions for the contamination at OU 1 and the other OUs on subsequent pages would include the standard levels in order to better comprehend the extent of the contamination	A table of the most recently established standards has been included in Appendix D Discussion of these standards is included in Section 3.2 9

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7	2-45	Mention is made at the end of the first paragraph that contamination has occurred downgradient to the french drain system What is the extent of this contamination and what are the plans for containing or remediating it? Will studies be undertaken to prevent a similar situation from developing at the french drain being installed at the 881 Hillside?	Contamination as a result of the Solar Ponds is being investigated in accordance with the schedule for OU4 The OU1 Work Plan describes monitoring and remediation activities at Hillside 881
8	2-54	We are intrigued by the existence of nitrate contamination upgradient of the West Spray Field Did the contamination move upgradient or did it come from somewhere else?	Nitrate contamination upgradient of the West Spray Field may be from offsite activities within the area of the clay pits or from mounding of the water table in the West Spray Field during irrigation in the past Additional monitoring wells are planned to investigate this
9	2-68	In the last paragraph mention is made of a Surface Water Community Relations Plan and a Surface Water Quality Video Although these activities were mentioned as having been outlined for the 1990 Surface Water Monitoring Plan, they also should have been included in the 1991 Surface Water Management Plan All community relations activities should be described and evaluated at least on an annual basis	This comment has been passed on to the groups dealing with the Surface Water Management Plan
10	2-73	The Cleanup Commission urges DOE to complete the studies described in the second paragraph that assess the interrelationship between groundwater and surface water ponds We encourage the completion of a full characterization before the new containment structure (as described in the Surface Water Management Plan to accommodate 100 year flows along Woman Creek) in the southeast buffer zone is constructed The discussion at the bottom of the page and continuing to page 2-74 about contaminant transport is confusing Are the implications the same if a contaminant is dissolved, in suspension, or in perhaps a colloidal form? If the current sampling protocol is only to analyze a filtered sample, we would encourage analysis of an unfiltered sample as well in order to evaluate under various forms of contaminant transport	The hydraulic connection between groundwater and the surface water in the ponds is under study The management of surface water is beyond the scope of this document In the 3rd quarter of 1991 RFP began sampling the groundwater for total metals and unfiltered Pu and Am The difference between the filtered and unfiltered values will be assessed in order to determine which forms of contaminant transport are occurring
11	Figure 2-6	The term "original" thrust fault is ambiguous	"Original" is inappropriate and the figure has been changed

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12	Figure 2-14	Some of the contours are located outside the data points and some deflect where there is no data Whether this was contoured by hand or computer, the algorithms do not obey strict rules of contouring In particular, the 1 0 isopleth in the NW corner of the map leads us to believe that we know with certainty, that contamination outside this line is lower than 1 0 when, in fact, there is no data there to show such Similar problems exist in Figure 2-18 The western set of contours "close" around a single point This is too interpretive	These drawings have been revised to be less confusing
13	3-6	The last sentence of the middle paragraph mentions that RFP is progressing towards compliance with the fully permitted groundwater monitoring regulations A description of exactly how the plant is out of compliance and what steps are being undertaken to attain compliance should be included in the discussion	The question asks in what regards the RFP is out of compliance with fully permitted groundwater monitoring requirements The RFP is not out of compliance with fully permitted groundwater regulations since these regulations are not yet applicable to groundwater at the RFP Instead, the RFP must comply with interim status groundwater monitoring requirements The RFP believes that it is in compliance with interim status groundwater monitoring requirements However, on September 5, 1991, the CDH submitted comments to the RFP on certain technical issues related to interim status groundwater monitoring The RFP is currently in the process of responding to those CDH comments, and evaluating the upgrades, if any, required for the interim status groundwater monitoring program Such upgrades, as well as the routine annual reports, will help the RFP establish a groundwater monitoring system that will attain compliance with fully-permitted groundwater regulations when those regulations are applicable
14	3-8	You mention that "a number of other units at RFP may be contaminated by hazardous waste or hazardous constituents," without providing even a brief description These "other units" should be described	Over 170 IHSSs have been identified in the IAG They have been briefly described in other RFP documents [RCRA 3004(u)] They have been assigned to OUs for further investigation and will be detailed in specific reports scheduled by the IAG This document cannot describe all IHSSs

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15	3-13	Point of Compliance - Vertical and Horizontal Vertical Why are the points of compliance set beforehand at the base of the upper aquifer if the absence of contamination in the lower sandstone units has not been ascertained Horizontal If groundwater contamination goes off-site there should be some provision for moving the point of compliance off-site	The CDH sets the points of compliance The vertical points of compliance are set at the base of the upper aquifer If lower sandstone units are hydraulically connected with upper water-bearing layers, they would be considered part of the uppermost aquifer and require monitoring as part of the point of compliance Sandstones below the uppermost aquifer are monitored to characterize the groundwater on a regular basis With regard to the horizontal location of the point of compliance, it is clearly specified in the regulations and is ultimately defined by CDH for RCRA units and EPA for CERCLA units In the future, if groundwater contamination goes offsite, DOE, EPA, and CDH will have to reach an agreement which defines the point of compliance
16	3-14	At the end of the first paragraph the statement is made, "The following are the elements of a groundwater protection standard " The second bullet listing these elements reads, "Concentration limits for hazardous constituents must 1) not exceed the background level of that constituent at the time the limit is specified " Tables 5-14, 19, 24, 29, 33, 38, and 48 in the <u>Background Geochemical Characterization Report</u>, 21 December 1990, list background values for Pu 239 that average 0163 pCi/l with a range of 0109 for the unweathered sandstone to 0223 for the valley fill alluvium Why would the criteria that a hazardous constituent concentration should not exceed background also not apply to radionuclides? The standard of 05 pCi/l for Pu is clearly above the background average of 0163 and also above the maximum value of 0223 Please explain the rationale for making such decisions	The water quality standards that apply to the RFP have been ongoing issues Additional text discussing the Colorado Water Quality Control Commission has been added The state has established 05 pCi/l as the standard for Pu Questions as to why the state selected this standard should be addressed to the state
17	3-15	Table 3-1 does not include the organics such as TCE or carbon tetrachloride Is this an oversight?	Table 3-1 identifies standards set by the CDH for specific constituents
18	3-25	The Cleanup Commission questions why the nearest domestic water use well downstream of the plant is only to be tested for plutonium We would recommend the full battery of analytes be included for evaluation	This is a recommendation of the Governor's Rocky Flats Scientific Panel only RFP believes this task should be performed by CDH It follows that CDH would determine the scope of analytes to be included

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19	Table 3-1	Does the * in the footnotes apply to the entire table? If so, it should appear in the title	The asterisk was erroneously deleted from the title
20	Table 3-2	++Hg, Cs, and Sr appear to be incorrectly or confusingly referenced in the footnotes Why are there no concentration limits proposed for the other isotopes of Pu, Am, and Cs? Do we know with certainty that they do not exist on site, or that they are below levels of concern?	The table has been revised to clarify applicable standards A standard for Am has been set by the state at 05 pCi/l The specific reason that no concentration limit has been set for Cs should be addressed to the State The groundwater at RFP is monitored for Pu 239/240, Am 241, and Cs 137
21	Table 3-2	Provided it refers to tritium, "H_3" should read H^3 or ^3H	Tritium has been corrected to read ^3H
22	4-25	No 7 Please provide more details of the nature and extent of anthropogenic contamination No 8 Why is the water filtered and what criteria establishes the use of a 0 45 micron filter? No 9 Plutonium, especially Pu 244, <u>does</u> occur naturally in natural ores of uranium (See <u>Handbook of Chemistry and Physics,</u> or see General Electric's "Chart of Nuclides ")	No 7 Anthropogenic contamination pertains to any contamination included by the activities of man This document pertains to contamination derived from plant activities Other anthropogenic contamination could be from other, non-RFP industrial activities or incident pollution such as particulates from car exhaust No 8 Water is sampled according to SOP GW 6 Filtration of some portions of a groundwater sample (such as that for dissolved metals analysis) with a 0 45 micron filter is required by EPA documents such as "Test Methods for Evaluating Solid Waste, Volume II Field Manual Physical/Chemical Methods," EPA Office of Solid Waste and Emergency Response, Washington, D C , November 1986 No 9 The statement has been changed to read Pu 238, 239.
23	4-26	In the prioritization list for analytes, Uranium 233 and 234 are listed Why is there a need to test for these isotopes?	The analysis of isotopes provides an indication of the stages of radioactivity It is an IAG requirement of analyze for Uranium 233/234, Uranium 235, and Uranium 238
24	8-6	In the last paragraph mention is made of the need for on-site labs to test the groundwater Is building 559 a candidate to house such a lab or would a totally new facility need to be designed? Could any other of the labs be upgraded to accomplish groundwater analysis? The Cleanup Commission supports the establishment of on-site labs to test groundwater in order to avoid monitoring delays	At present it is not practical to use onsite labs to test groundwater Cost is a factor that has to be considered as much as turnaround times Both of these factors are being evaluated The selection of which lab or labs would be used has not been made at this time

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No	Page No	Reviewer's Comment	Response
25	8-7 through 8-11	As members of the community with which RFP "interacts," we view this community interaction section with curiosity These pages are more appropriate for a RFP employee handbook and not for a public document The overall impression given is that basically the problems are not that bad at RFP, the public tends to overreact, and that the purpose of community interaction is to placate the public with "happy talk" These discussions of your community relations strategies, although revealing, are not what we expect to find in this plan We are more interested in, and will evaluate you by, the execution and outcome of your efforts If you plan your efforts with the assumption that what we need is "happy talk" then be assured that you will fail	
		The public wants information We want to know what types of contaminants are present, how fast and to what extent they have spread, what is being done to contain them, and when and how they will be removed Your community relations plan should address how this information is dispersed without making a value judgement that we as the public should view everything as a "non-problem"	The Annual RCRA Report and other CERCLA reports provide the community with information on the types of contaminants present, how far and to what extent they have spread, and what is being done for remediation The schedule for preparation of these reports is given in the IAG
		The Governor's Scientific Panel on Monitoring systems in their October 1990 report addresses how information should be relayed to the public (See appendix seven of the Panel's report) Please review this material and incorporate it into future versions of this plan	Text has been added to include Public Response Comment Resolution Forms as part of the interaction with the community
		As future versions of this plan do evolve, kindly skip the employee handbook material and provide us with the specific plans and information that truly address the issues surrounding the groundwater protection and monitoring program	

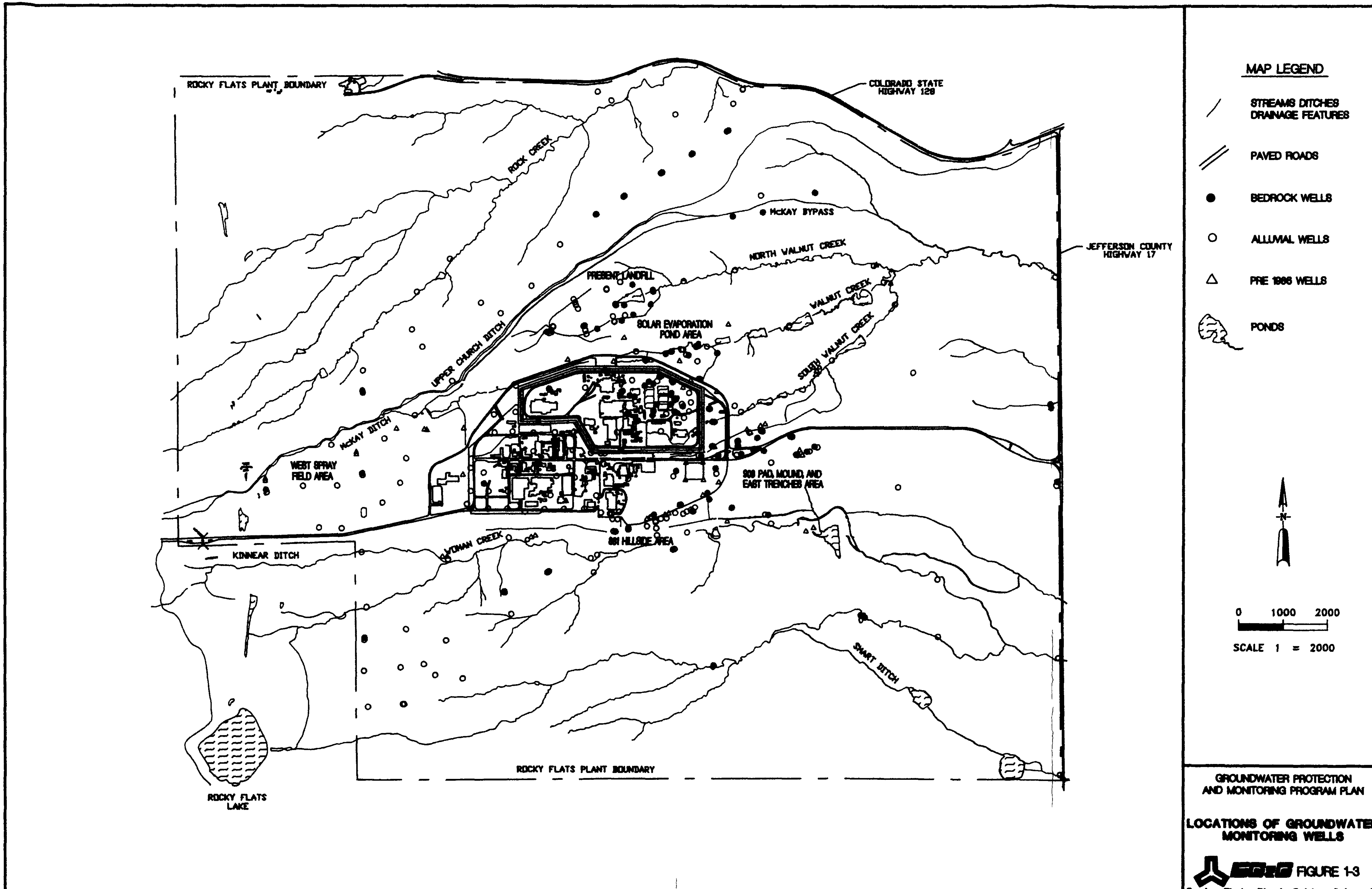
NOTICE

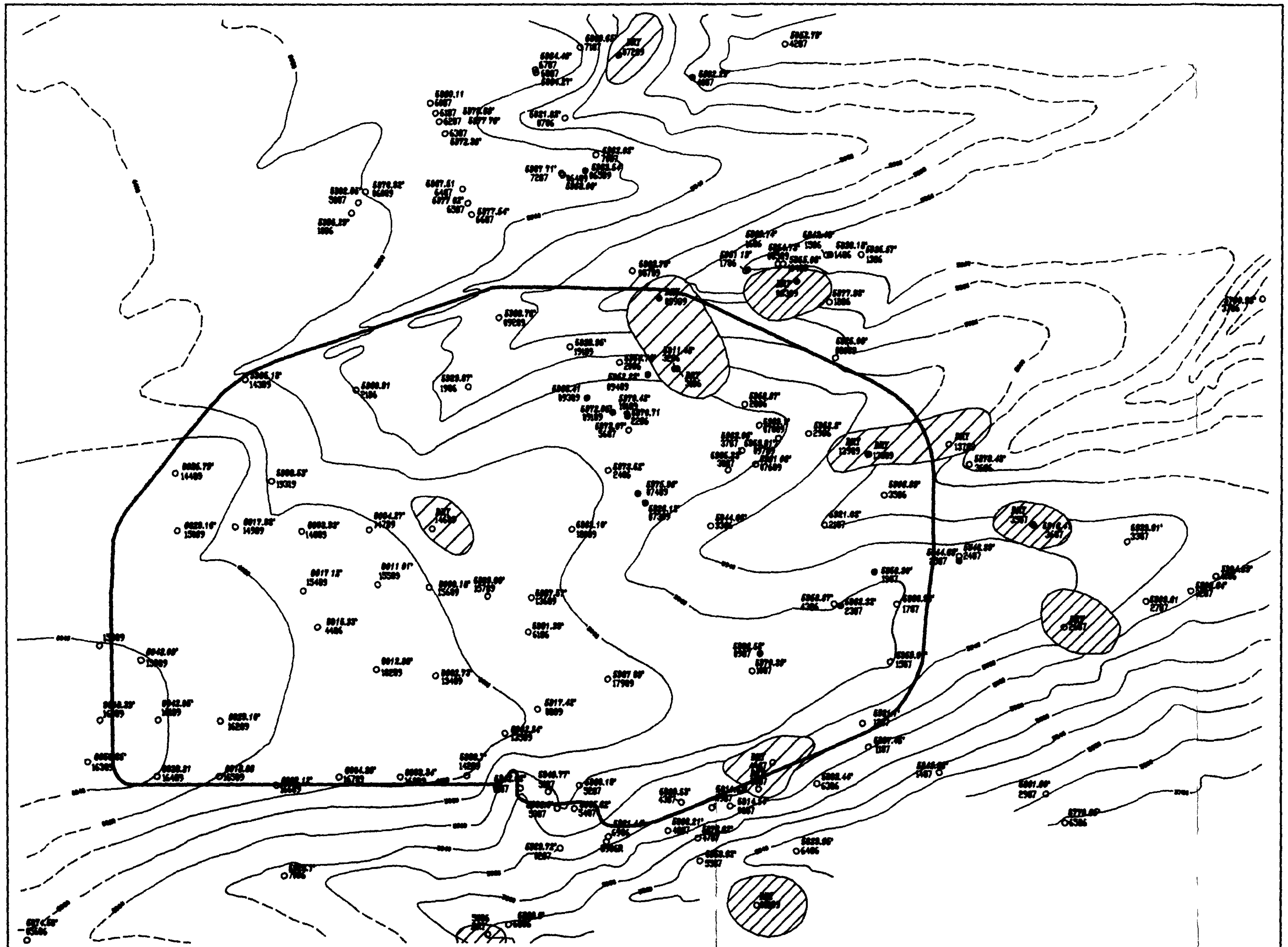
This document (or documents) is oversized for 16mm microfilming, but is available in its entirety on the 35mm fiche card referenced below:

Document # 000375

Titled: Groundwater Protection and Monitoring Program Plan Well and PIEZOMETER Locations Individual Hazardous Substance Sites Plate 1

Fiche location: A-SW -M30


ROCKY FLATS PLANT BOUNDARY
COLORADO STATE HIGHWAY 128
ROCK CREEK
McKAY BYPASS
NORTH WALNUT CREEK
PRESENT LANDFILL
SOLAR EVAPORATION POND AREA
WALNUT CREEK
SOUTH WALNUT CREEK
JEFFERSON COUNTY HIGHWAY 17
UPPER CHURCH DITCH
McKAY DITCH
WEST SPRAY FIELD AREA
903 PAD, MOUND, AND EAST TRENCHES AREA
881 HILLSIDE AREA
WOMAN CREEK
KINNEAR DITCH
SMART DITCH
ROCKY FLATS LAKE
ROCKY FLATS PLANT BOUNDARY
MAP LEGEND
STREAMS DITCHES DRAINAGE FEATURES
PAVED ROADS
BEDROCK WELLS
ALLUVIAL WELLS
PRE 1986 WELLS
PONDS
N
0 1000 2000
SCALE 1 = 2000
GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN
LOCATIONS OF GROUNDWATER MONITORING WELLS
EG&G FIGURE 1-3
Rocky Flats Plant, Golden, Colorado



MAP LEGEND

Wells shown are only those open to uppermost hydrostratigraphic unit

5908.87' Water level elevation above sea level

Anomalously dry area

Water level elevation contours

All water level data collected April, 1990.

N

0 400 800

SCALE 1 = 800
CONTOUR INTERVAL 20

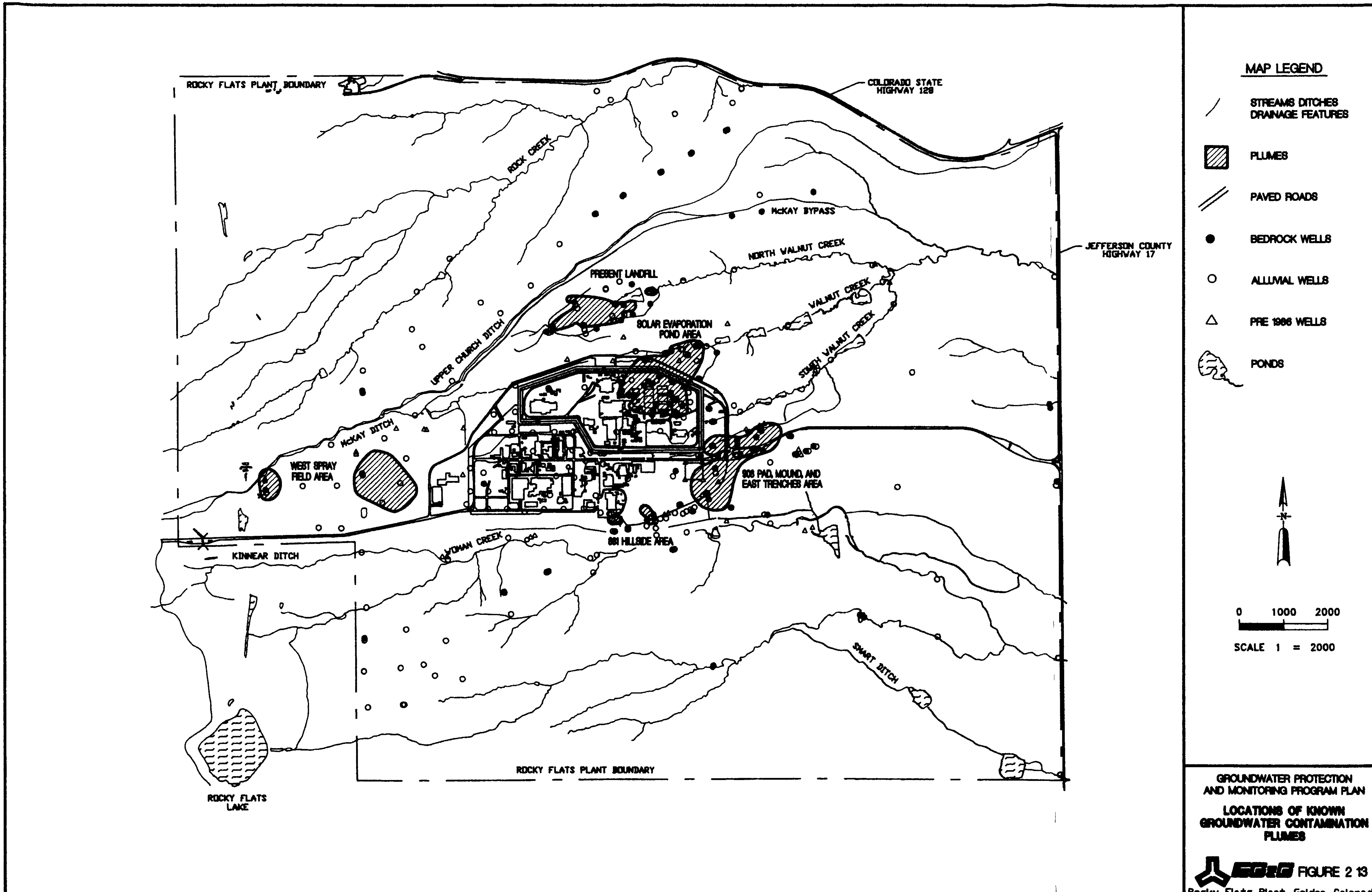
EG&G, 1991b

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

WATER LEVEL CONTOUR MAP
UPPERMOST HYDROSTRATIGRAPHIC UNIT

EG&G FIGURE 2 12

Rocky Flats Plant, Golden, Colorado

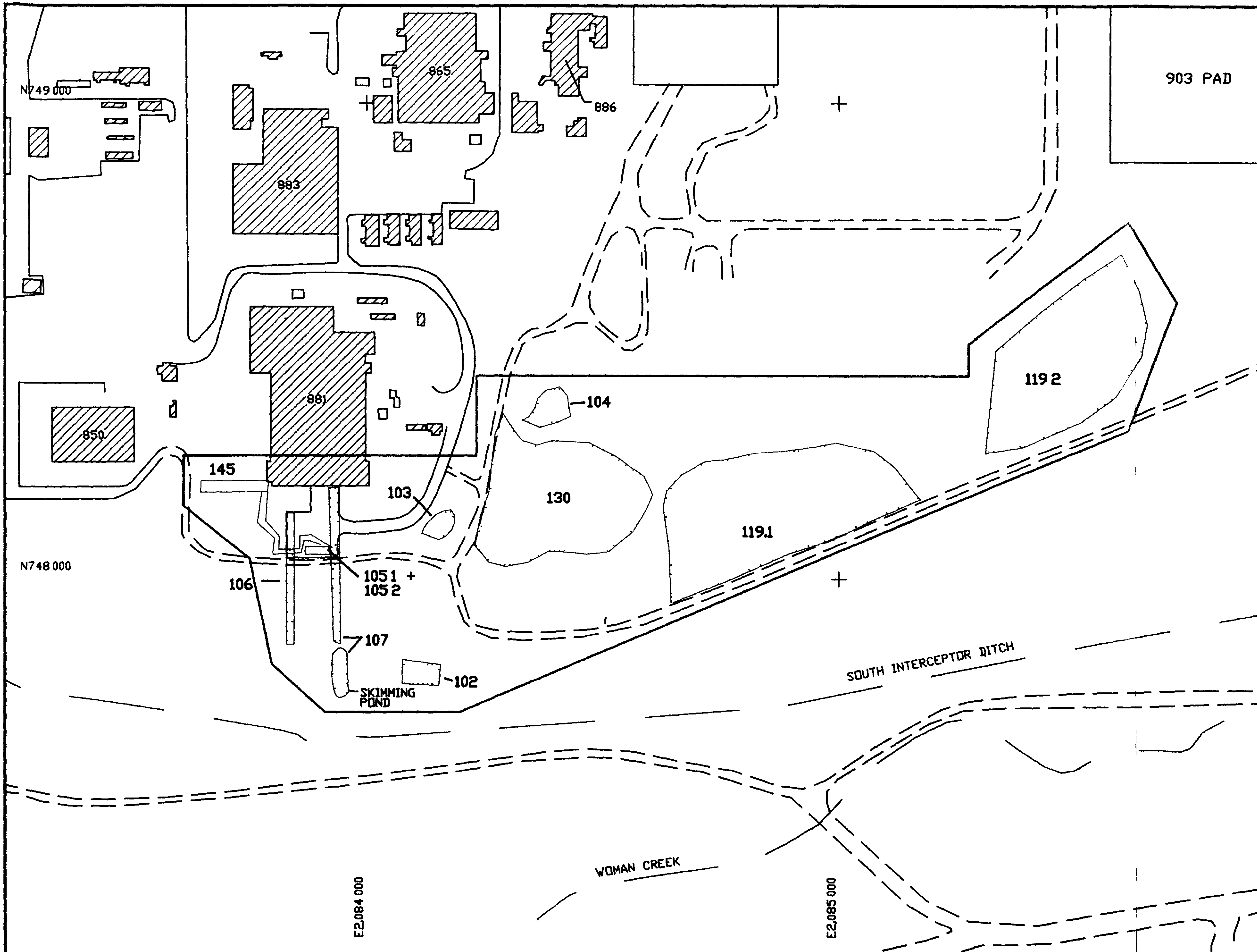


GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

LOCATIONS OF KNOWN GROUNDWATER CONTAMINATION PLUMES

EG&G FIGURE 2 13

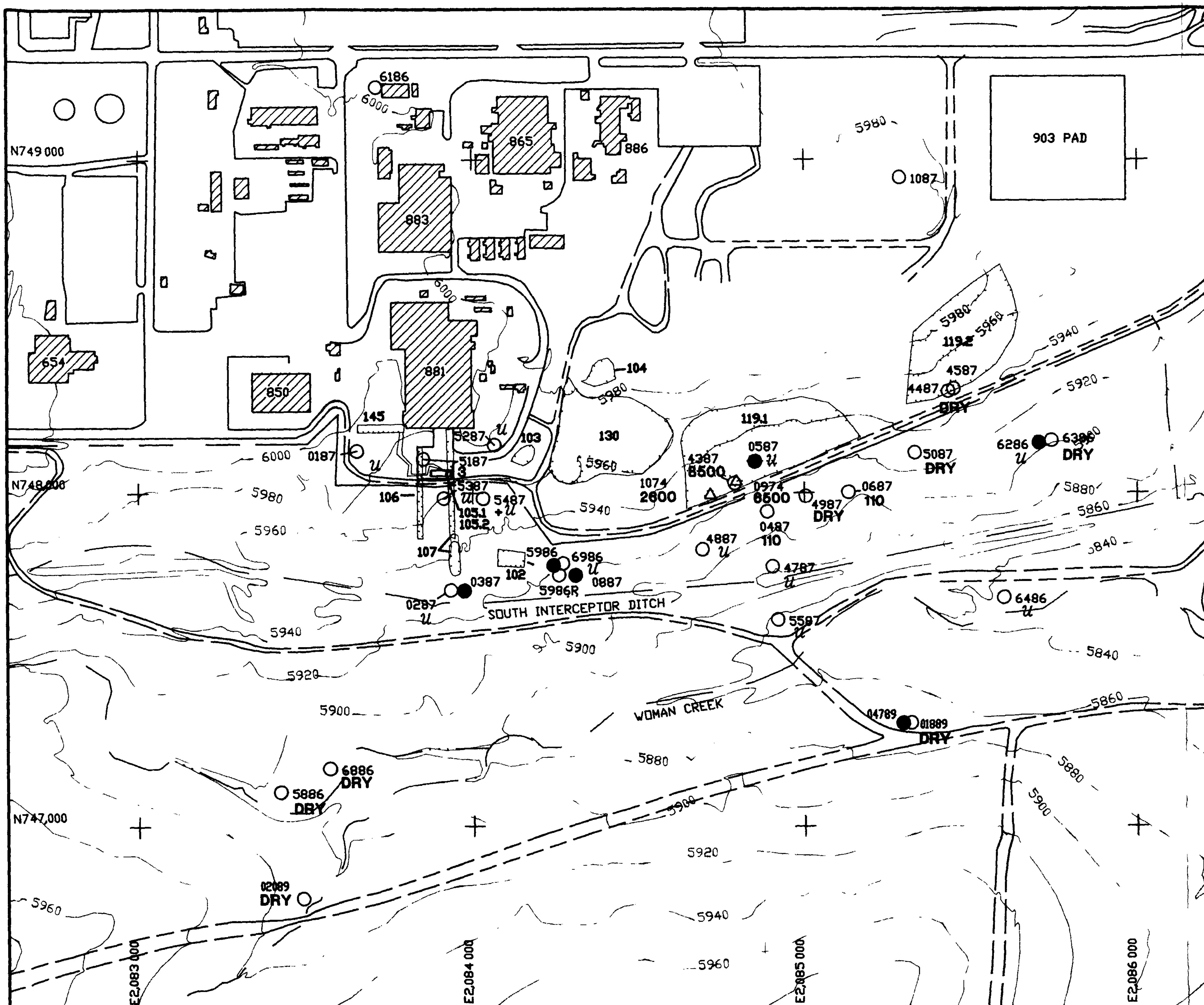
Rocky Flats Plant, Golden, Colorado



GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

OPERABLE UNIT 1
881 HILLSIDE

EG&G FIGURE 2 14
Rocky Flats Plant, Golden, Colorado



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS)

○ ALLUVIAL MONITORING WELL

● BEDROCK MONITORING WELL

△ PRE 1986 WELL

TRICHLOROETHENE CONCENTRATIONS

35 DATA IN ug/l

u ANALYZED BUT NOT DETECTED

N

0 150 300

SCALE 1 = 300

CONTOUR INTERVAL = 20

PLUME DATA FROM 1989
RCRA ANNUAL GROUNDWATER MONITORING
REPORT FOR REGULATED UNITS

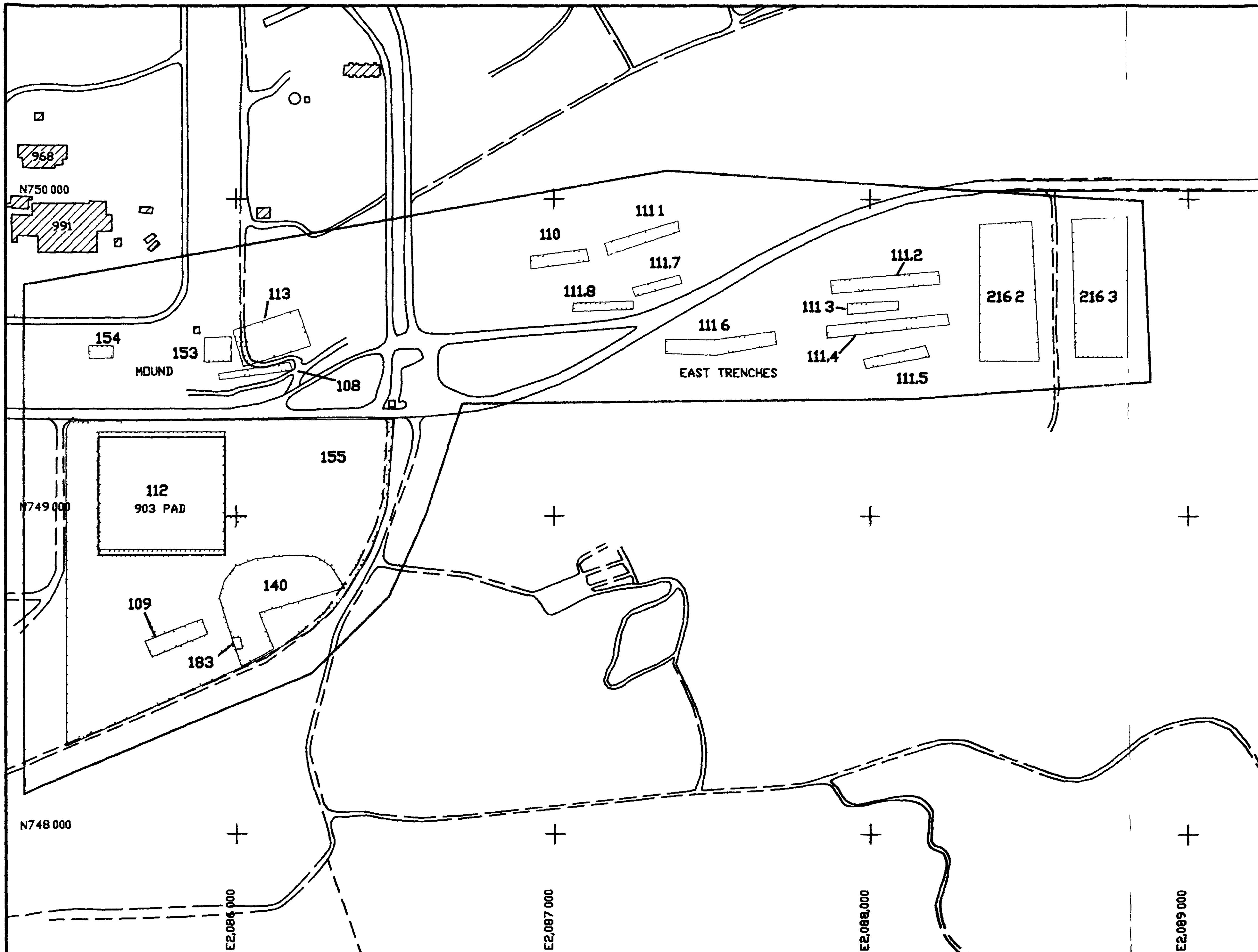
GROUNDWATER PROTECTION
AND MONITORING PROGRAM PLAN

TRICHLOROETHENE CONCENTRATIONS IN THE UPPERMOST
HYDROSTRATIGRAPHIC GROUNDWATER FLOW SYSTEM
881 HILLSIDE

EG&G

FIGURE 2 15

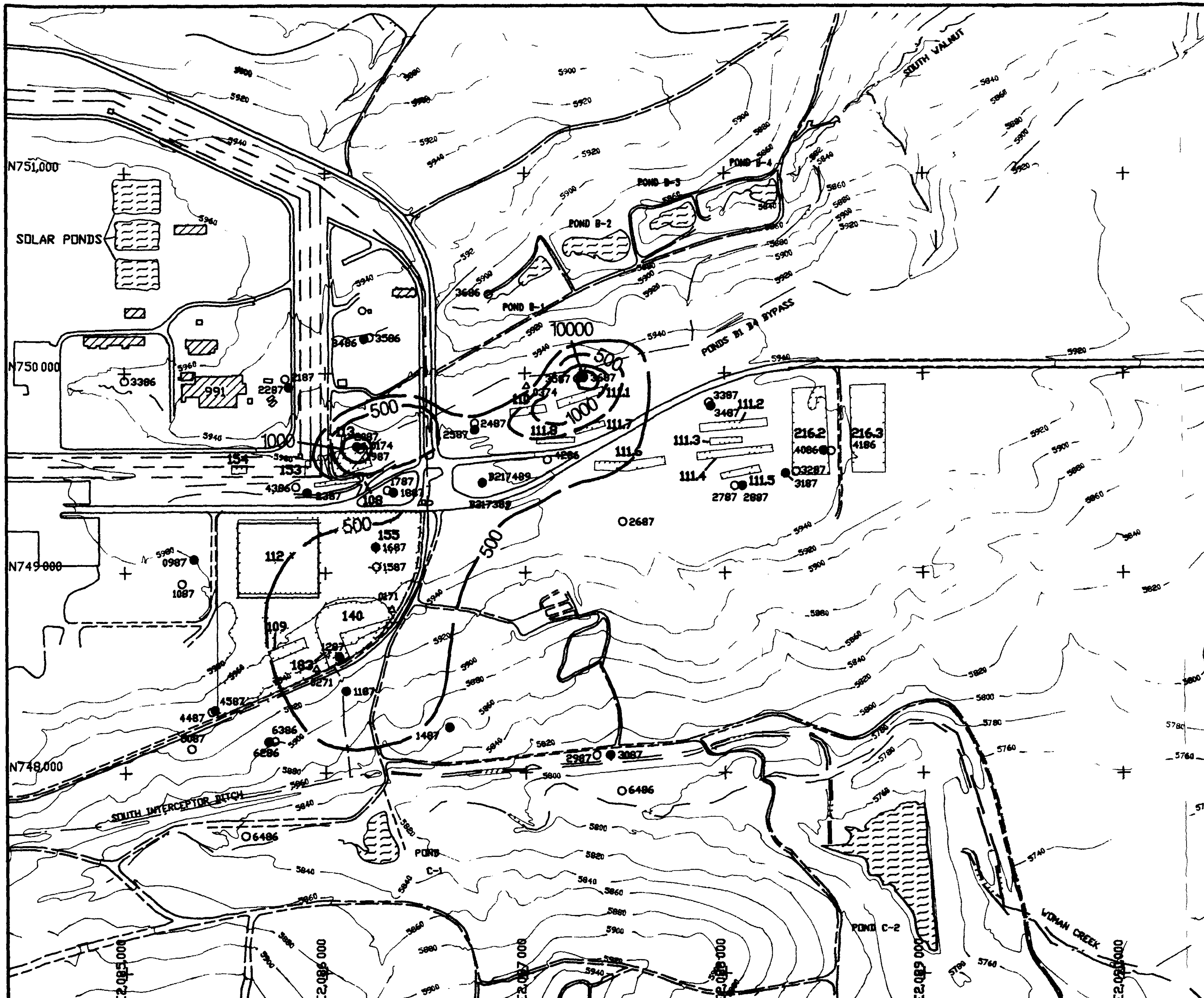
Rocky Flats Plant, Golden, Colorado



GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

OPERABLE UNIT 2
903 PAD, MOUND
AND EAST TRENCHES

EG&G FIGURE 2 16
Rocky Flats Plant, Golden, Colorado



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS)

500 LINE OF EQUAL TCE CONCENTRATION (ug/l) DASHED WHERE APPROXIMATELY LOCATED

2787 O ALLUVIAL MONITORING WELL

2887 ● BEDROCK MONITORING WELL

3187 Δ PRE 1986 WELL

N

0 250 500

SCALE 1 = 500

CONTOUR INTERVAL = 20

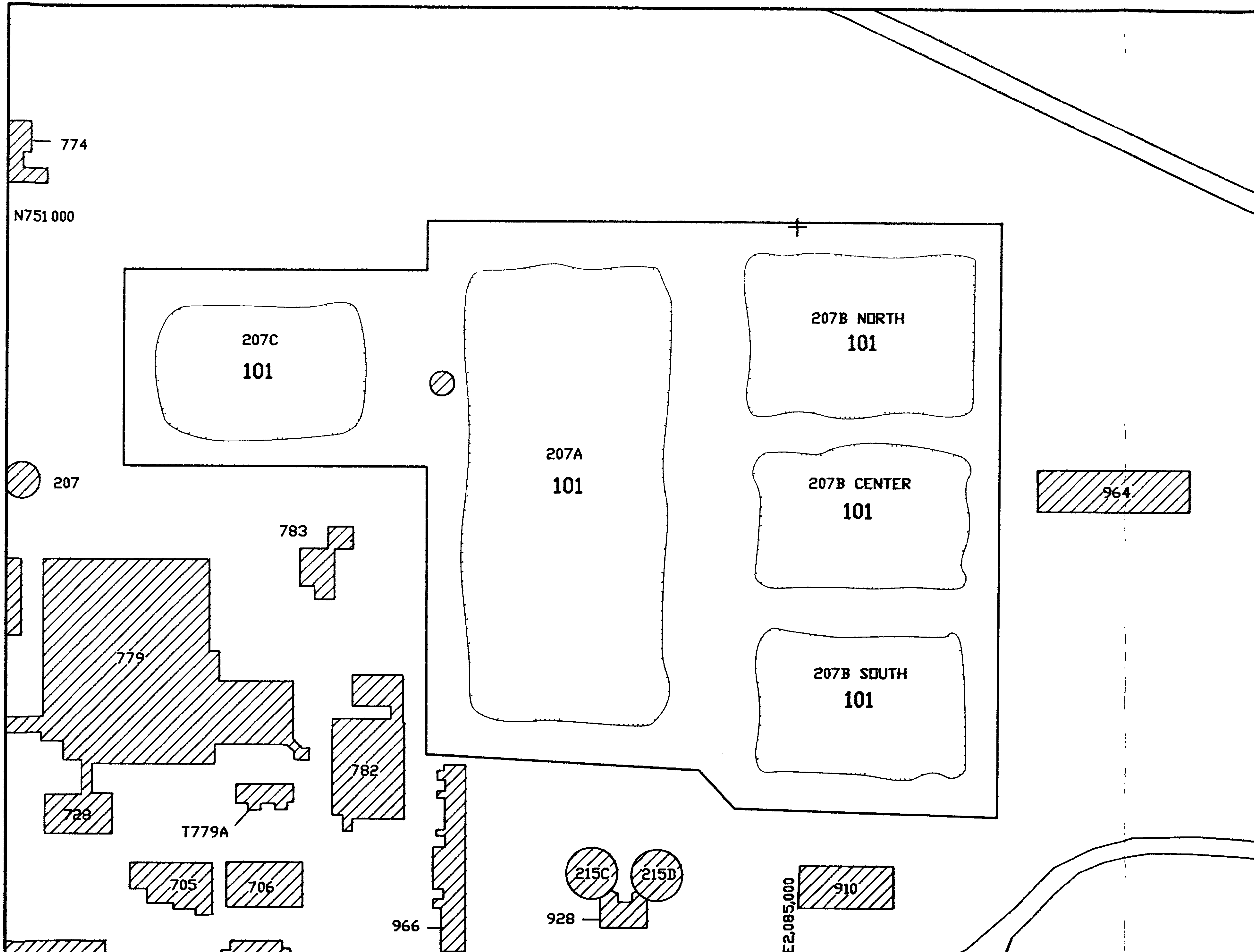
PLUME DATA FROM 1989 RCRA ANNUAL GROUNDWATER MONITORING REPORT FOR REGULATED UNITS

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

TRICHLOROETHENE CONCENTRATION ISOPLETHS IN THE UPPERMOST HYDROSTRATIGRAPHIC GROUNDWATER FLOW SYSTEM 903 PAD, MOUND, AND EAST TRENCHES

EG&G Rocky Flats Plant, Golden, Colorado

FIGURE 2 17

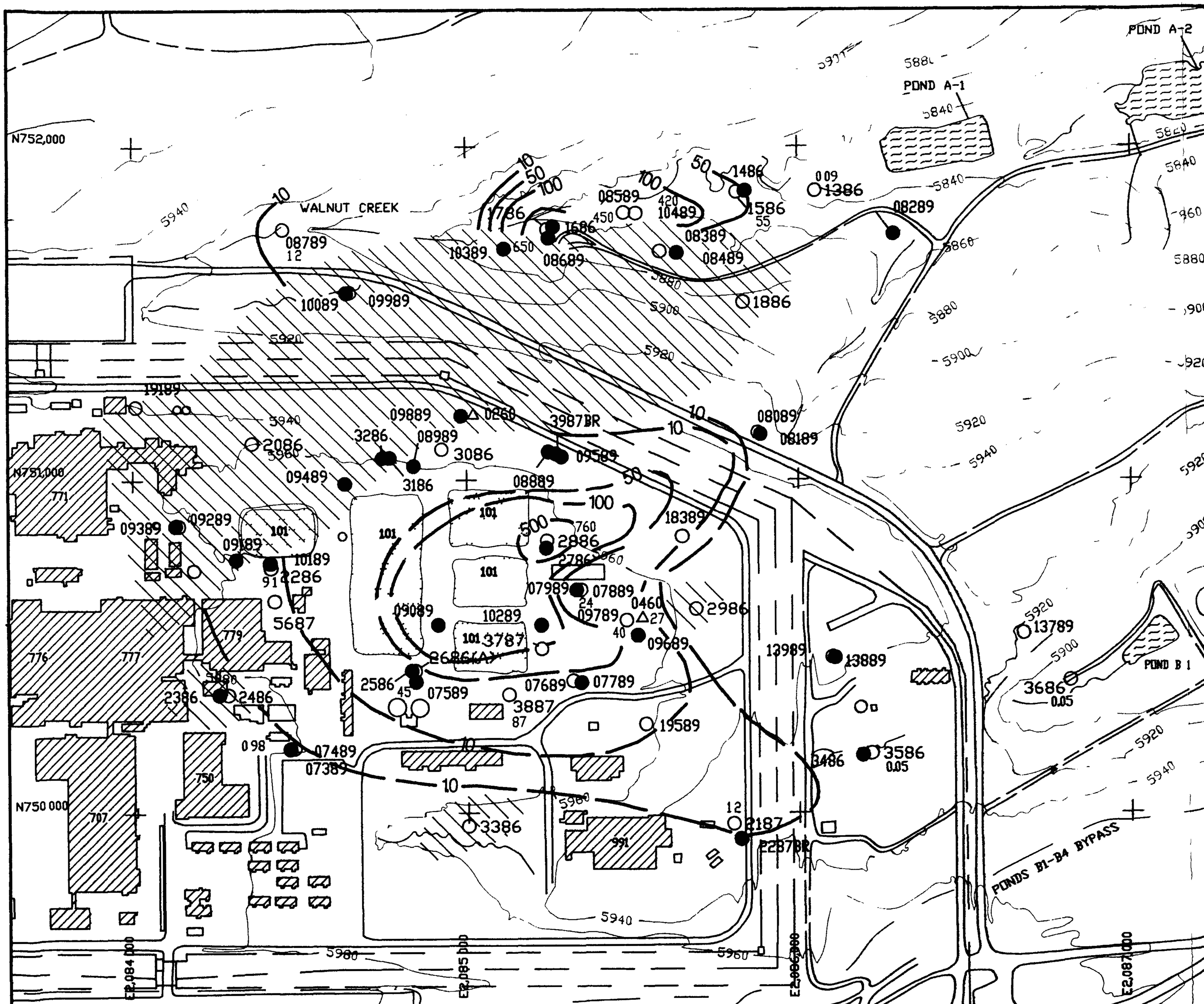


GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

OPERABLE UNIT 4 SOLAR PONDS

EG&G FIGURE 2-18

Rocky Flats Plant, Golden, Colorado



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS)

ALLUVIAL MONITORING WELL

BEDROCK MONITORING WELL

PRE 1986 MONITORING WELL

400 LINE OF EQUAL CONCENTRATION (mg/l) DASHED WHERE APPROXIMATELY LOCATED

08289 WELL NUMBER/SYMBOL

0 09 NITRATE/NITRITE AS N CONCENTRATION (mg/l)

UNSATURATED MATERIALS

N

0 150 300

SCALE 1 = 300
CONTOUR INTERVAL = 20

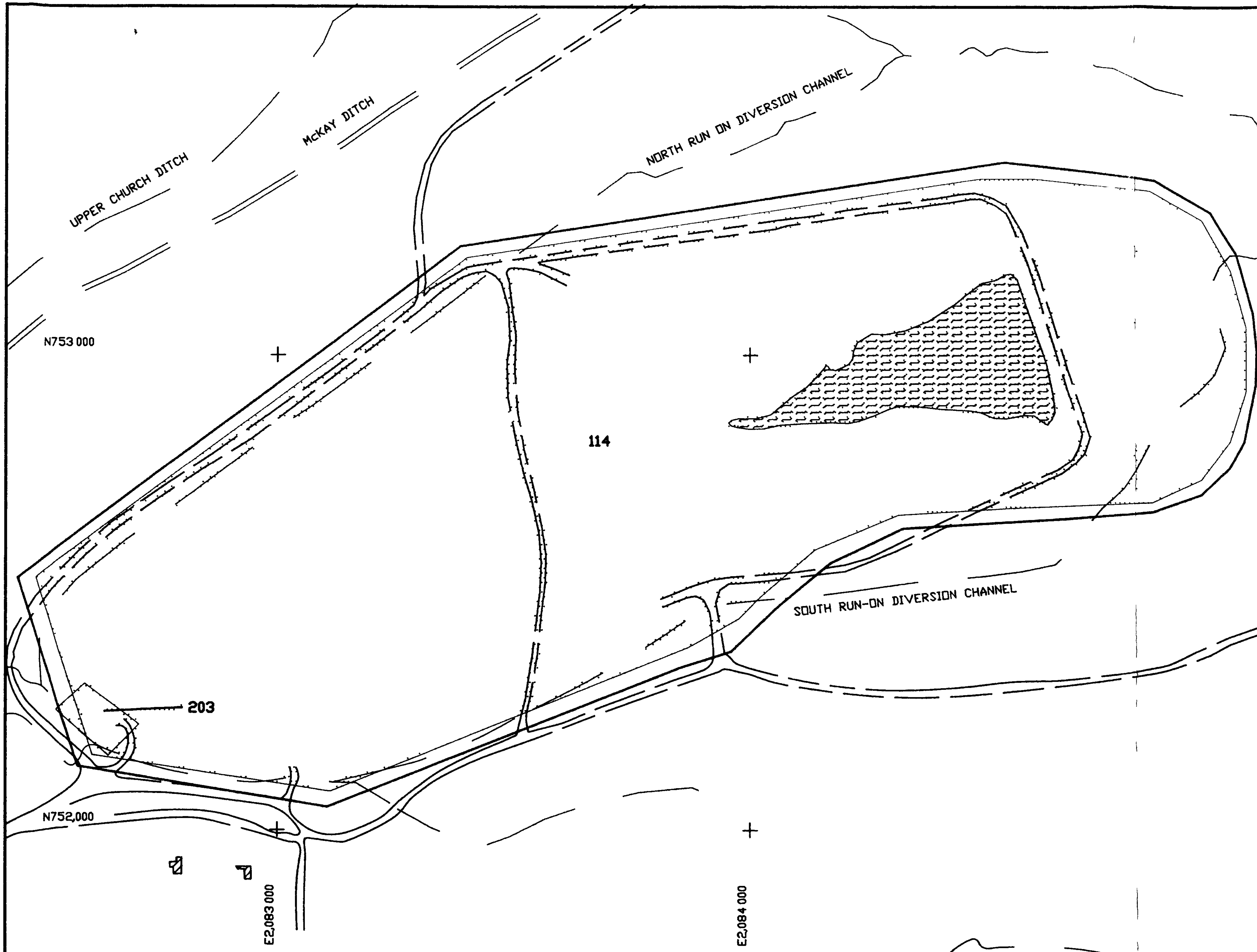
PLUME DATA FROM 1990
RCRA ANNUAL GROUNDWATER MONITORING
REPORT FOR REGULATED UNITS

GROUNDWATER PROTECTION
AND MONITORING PROGRAM PLAN

NITRATE/NITRITE AS N CONCENTRATION ISOPLETHS IN
UPPERMOST HYDROSTRATIGRAPHIC GROUNDWATER FLOW SYSTEM
SOLAR PONDS

EG&G
Rocky Flats Plant, Golden, Colorado

FIGURE 2 19

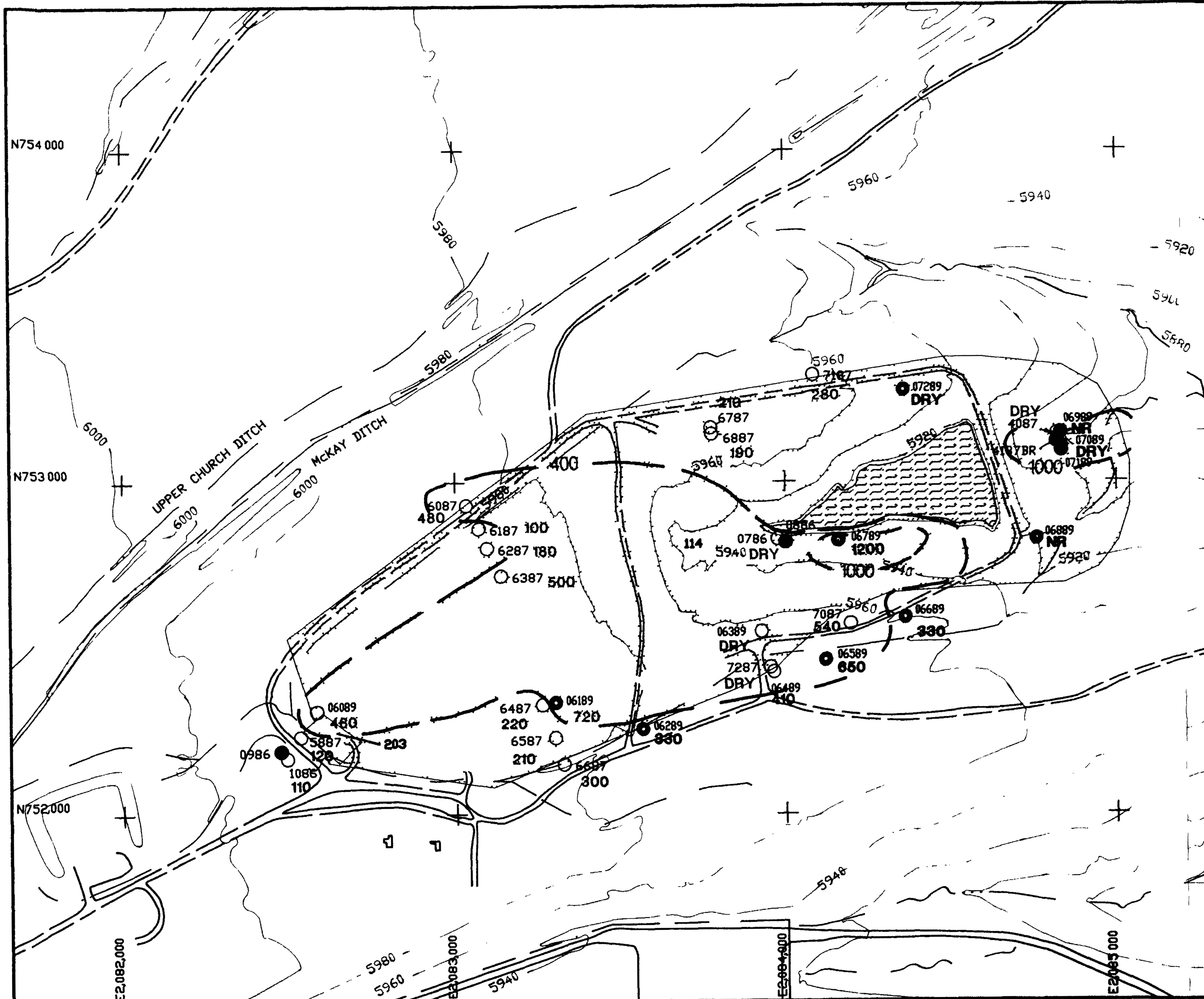


GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

OPERABLE UNIT 7
PRESENT LANDFILL

EG&G FIGURE 2 20

Rocky Flats Plant, Golden, Colorado



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS)

○ ALLUVIAL MONITORING WELL

WEATHERED BEDROCK MONITORING WELL

● UNWEATHERED BEDROCK MONITORING WELL

220 TDS CONCENTRATION IN ALLUVIAL GROUND WATER (mg/l)

330 TDS CONCENTRATION IN WEATHERED BEDROCK GROUND WATER (mg/l)

400 LINE OF EQUAL TDS CONCENTRATION (mg/l) DASHED WHERE APPROXIMATELY LOCATED CONTOUR INTERVAL VARIES

DRY INSUFFICIENT WATER FOR METALS ANALYSIS

NR DATA NOT YET RECEIVED

N

0 150 300

SCALE 1 = 300

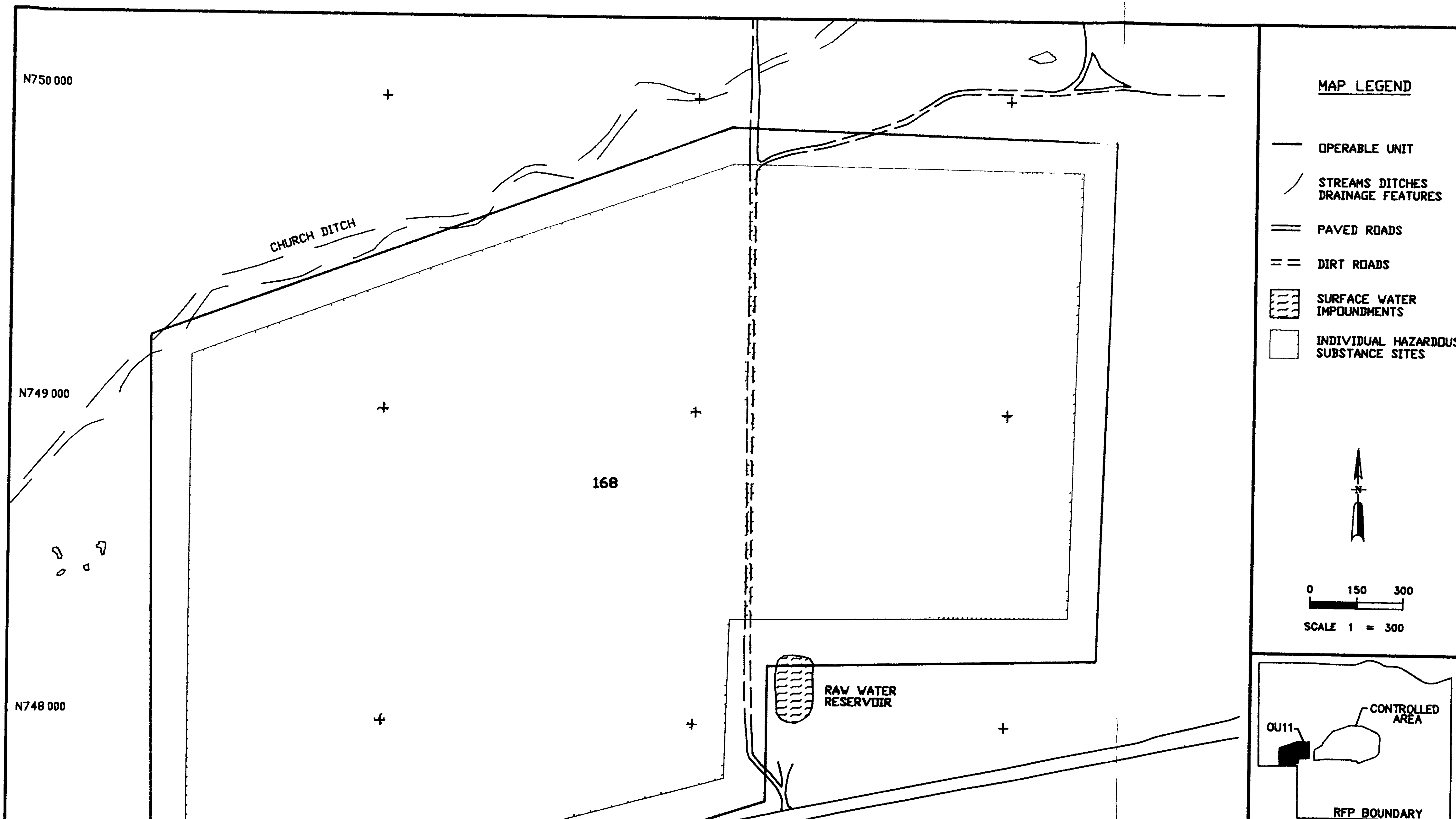
PLUME DATA FROM 1989 RCRA ANNUAL GROUNDWATER MONITORING REPORT FOR REGULATED UNITS

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

TOTAL DISSOLVED SOLIDS IN THE UPPERMOST HYDROSTRATIGRAPHIC GROUNDWATER FLOW SYSTEM PRESENT LANDFILL

EG&G Rocky Flats Plant, Golden, Colorado

FIGURE 2 21

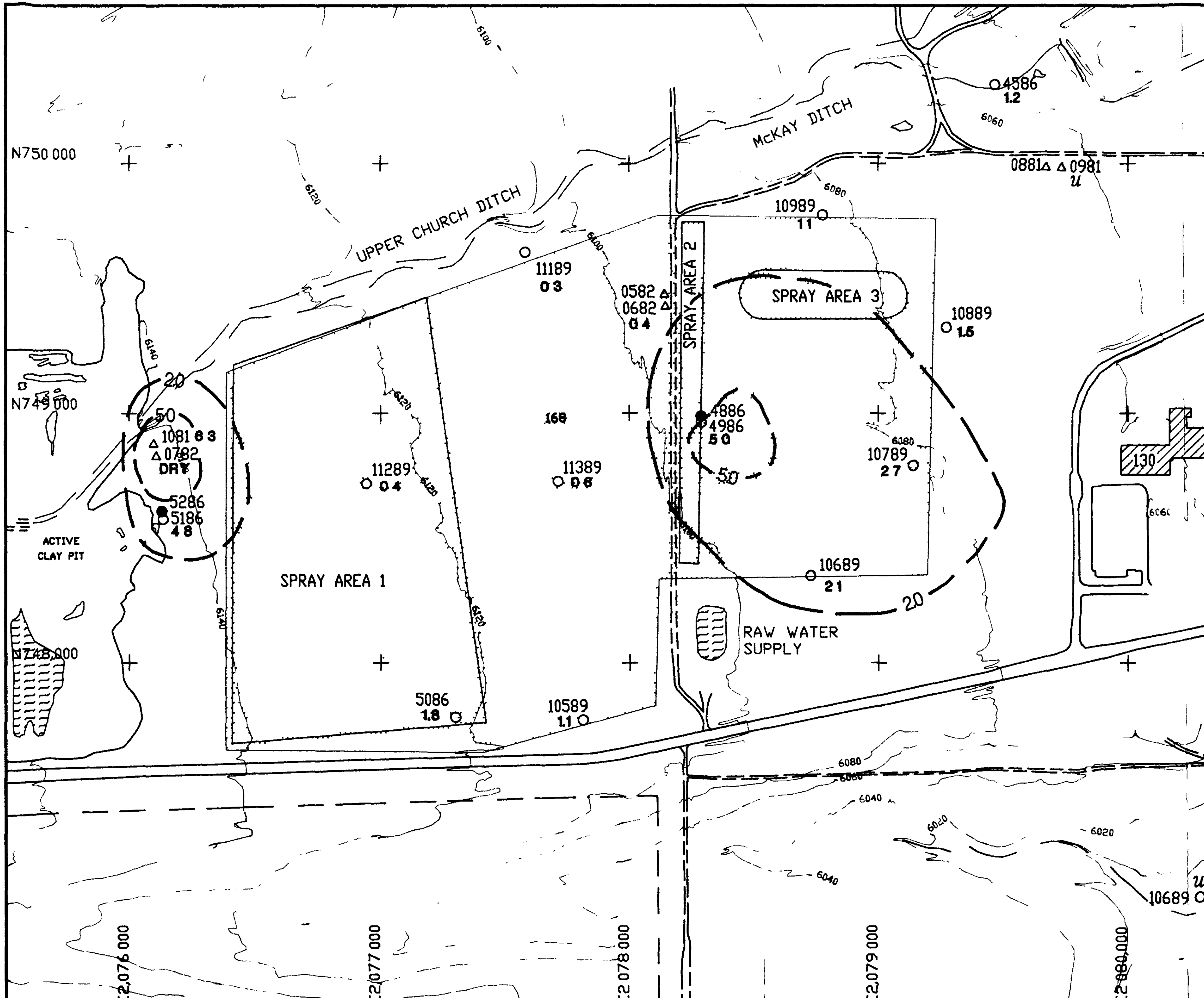


GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

OPERABLE UNIT 11
WEST SPRAY FIELD

EG&G FIGURE 2-22

Rocky Flats Plant, Golden, Colorado



EXPLANATION

- INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS)
- ○ ALLUVIAL MONITORING WELL
- ● BEDROCK MONITORING WELL
- △ PRE 1986 MONITORING WELL
- 1.2 NITRATE/NITRITE AS N CONCENTRATION IN ALLUVIAL GROUND WATER (mg/l)
- 20 LINE OF EQUAL NITRATE/NITRITE AS N CONCENTRATION (mg/l) DASHED WHERE APPROXIMATELY LOCATED
- DRY INSUFFICIENT WATER FOR INORGANIC ANALYSIS
- u NITRATE/NITRITE AS N CONCENTRATION BELOW DETECTION LIMIT

N

0 200 400

SCALE 1 = 400

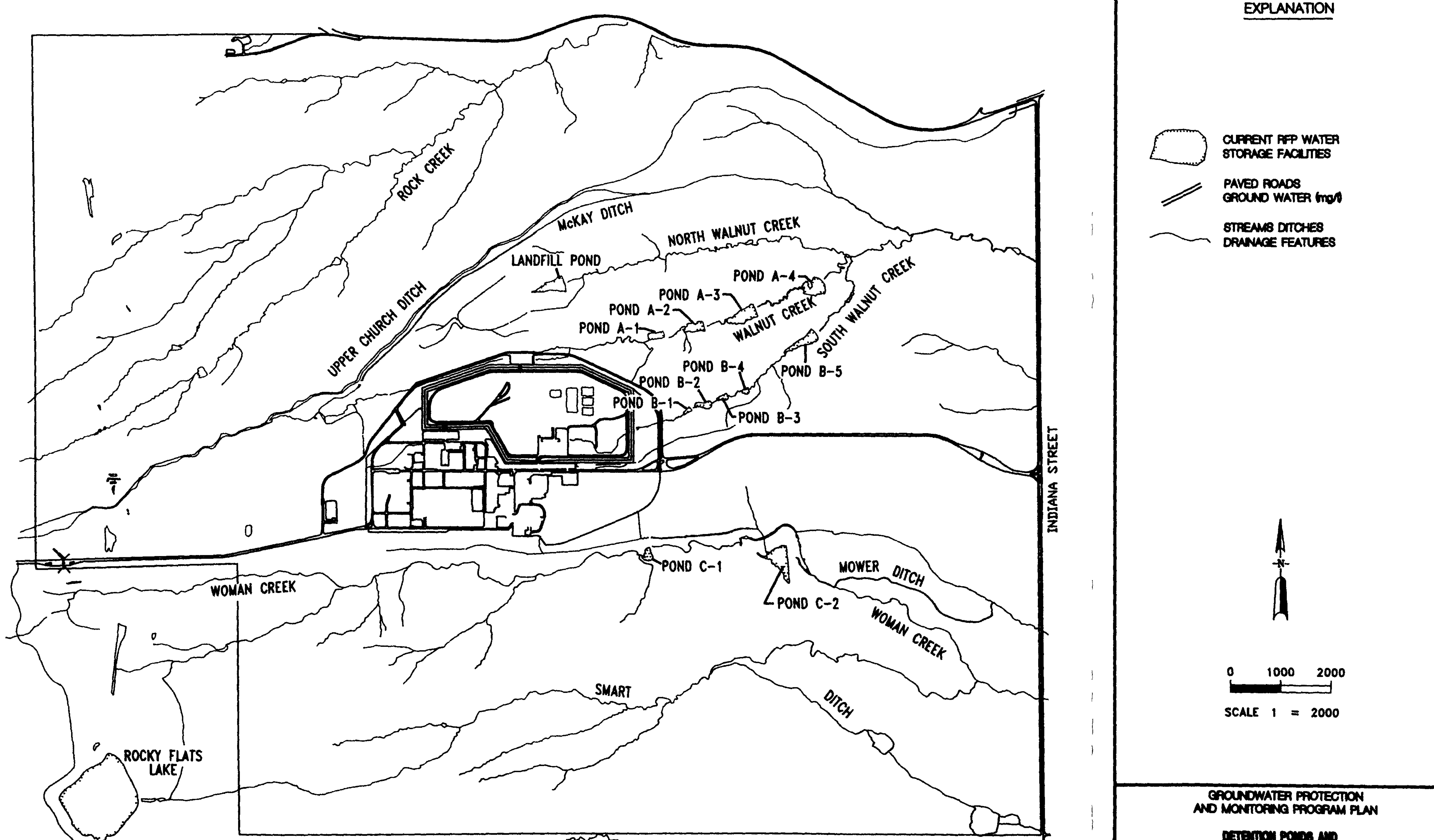
PLUME DATA FROM 1989 RCRA ANNUAL GROUNDWATER MONITORING REPORT FOR REGULATED UNITS

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

NITRATE/NITRITE AS N CONCENTRATION ISOPLETHS IN THE UPPERMOST HYDROSTRATIGRAPHIC GROUNDWATER FLOW SYSTEM WEST SPRAY FIELD

EG&G Rocky Flats Plant, Golden, Colorado

FIGURE 2 23

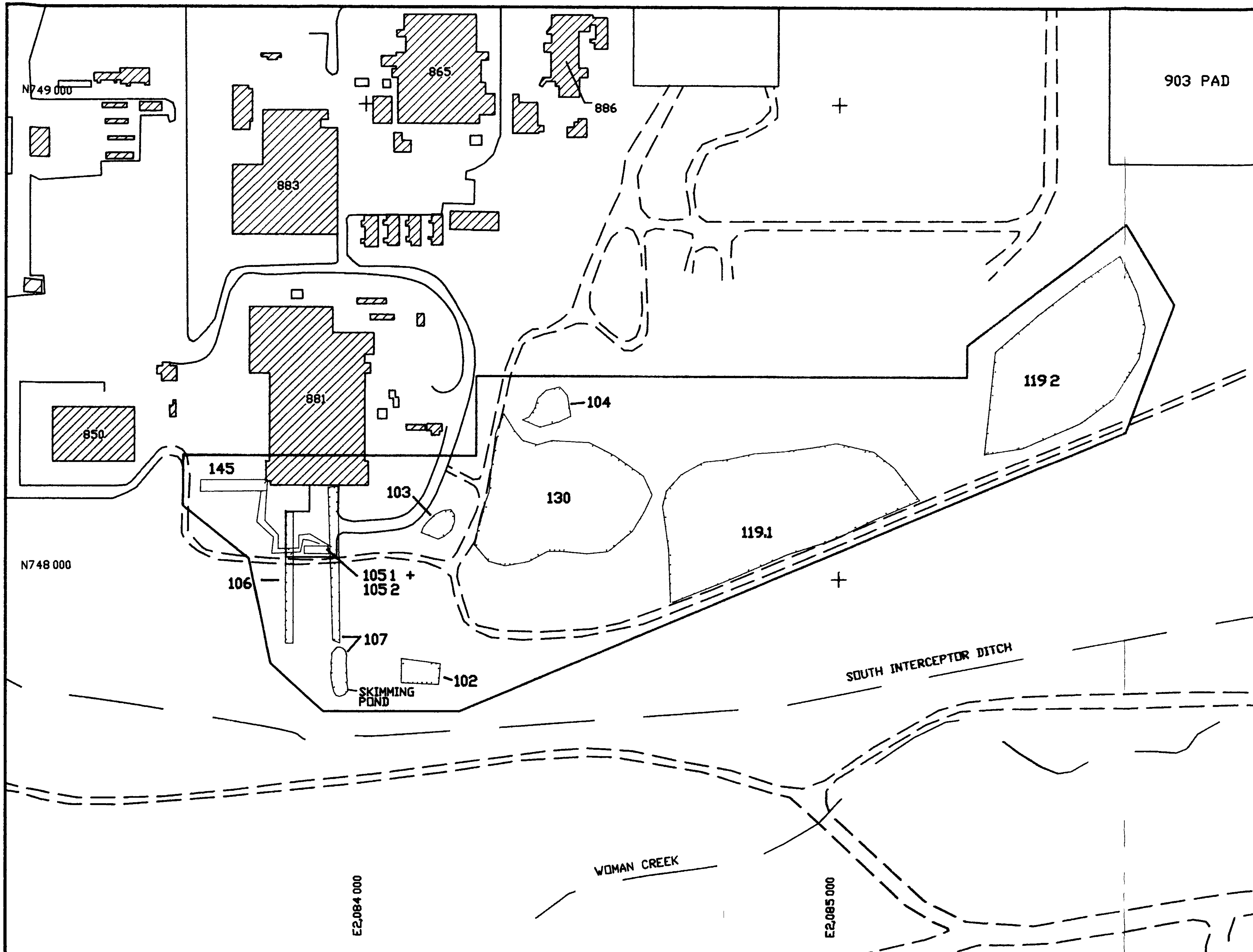


GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

DETENTION PONDS AND LIQUID EFFLUENT WATERCOURSES

EG&G Rocky Flats Plant, Golden, Colorado

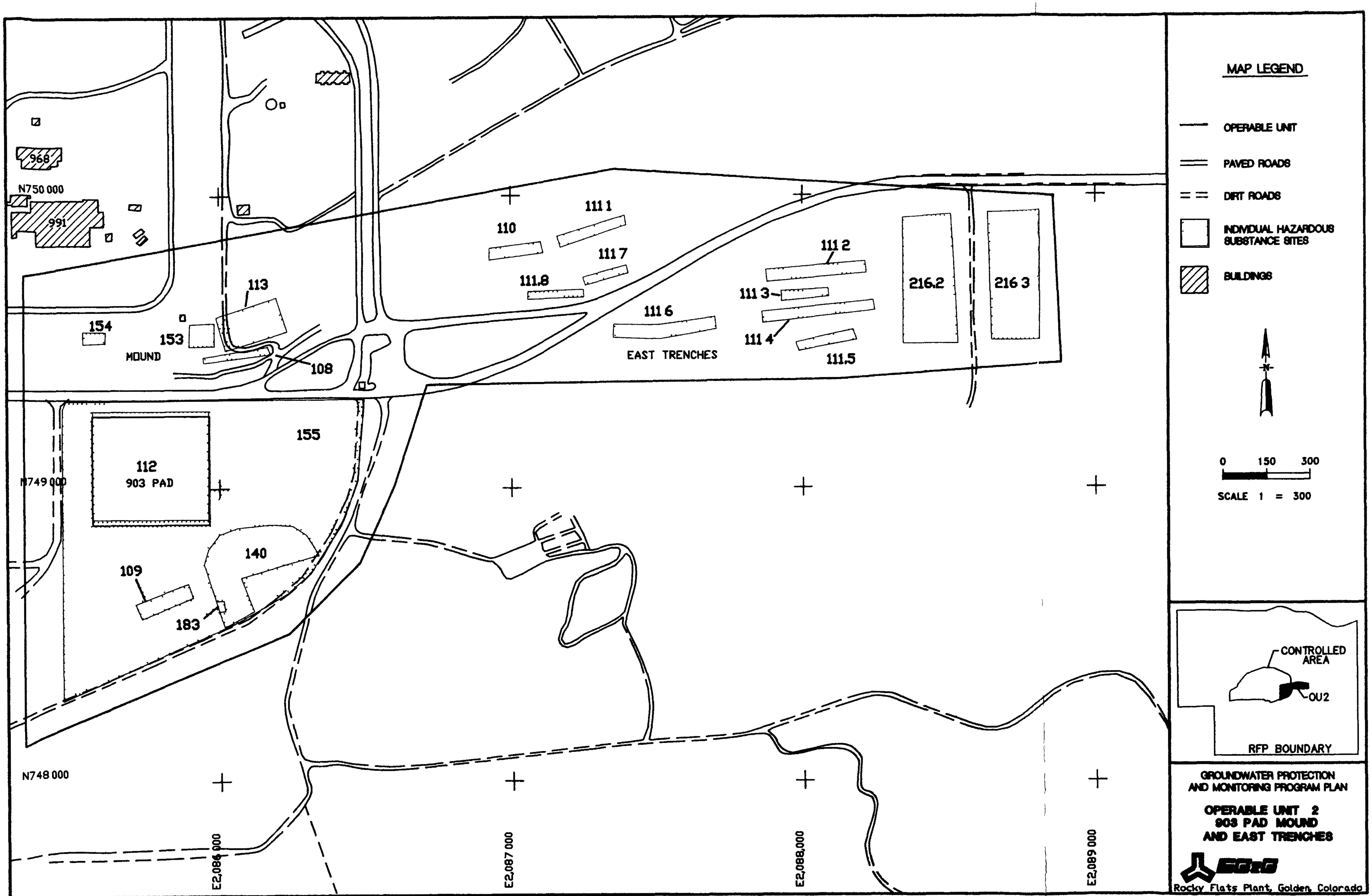
FIGURE 2 25

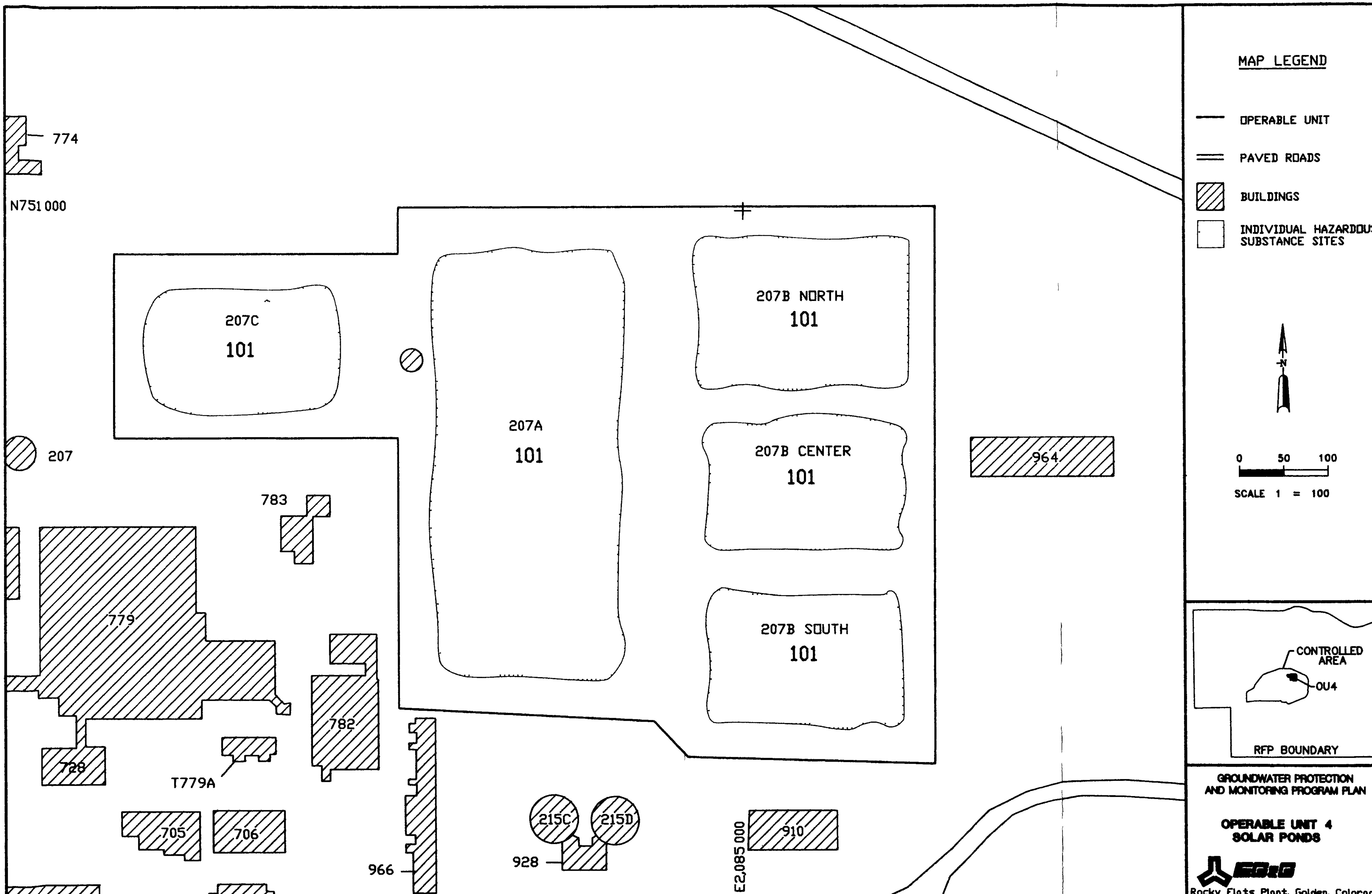


GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

OPERABLE UNIT 1
881 HILLSIDE

EG&G
Rocky Flats Plant, Golden, Colorado

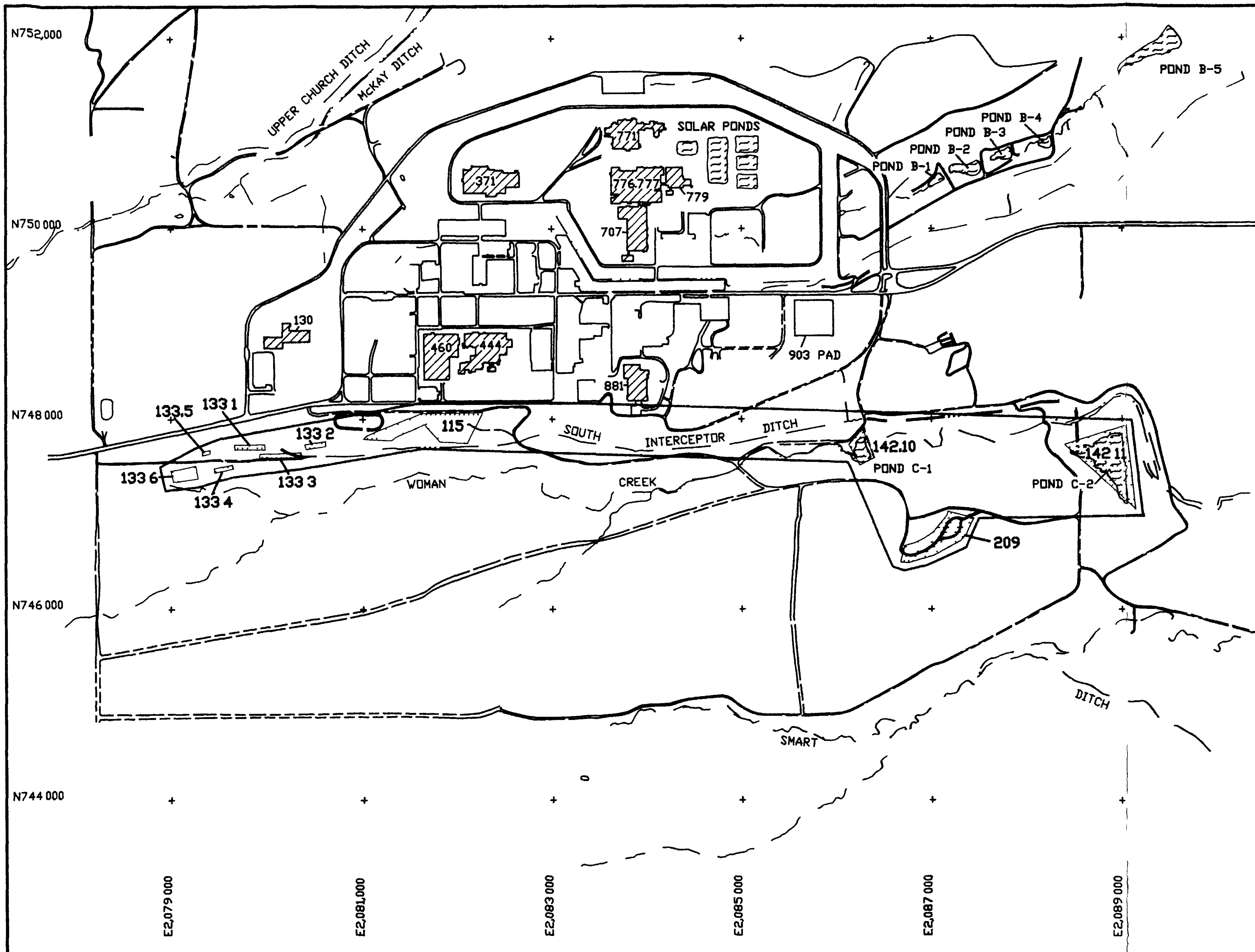

MAP LEGEND
OPERABLE UNIT
PAVED ROADS
DIRT ROADS
INDIVIDUAL HAZARDOUS SUBSTANCE SITES
BUILDINGS
N
0 150 300
SCALE 1 = 300
CONTROLLED AREA
OU2
RFP BOUNDARY
GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN
OPERABLE UNIT 2
903 PAD MOUND
AND EAST TRENCHES
EG&G
Rocky Flats Plant, Golden, Colorado
968
991
N750 000
N749 000
N748 000
E2,086 000
E2,087 000
E2,088,000
E2,089 000
110
111 1
111 7
111.8
113
154
153
MOUND
108
111 6
EAST TRENCHES
111 2
111 3
111 4
111.5
216.2
216 3
155
112
903 PAD
140
109
183



GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

OPERABLE UNIT 4
SOLAR PONDS

EG&G
Rocky Flats Plant, Golden, Colorado

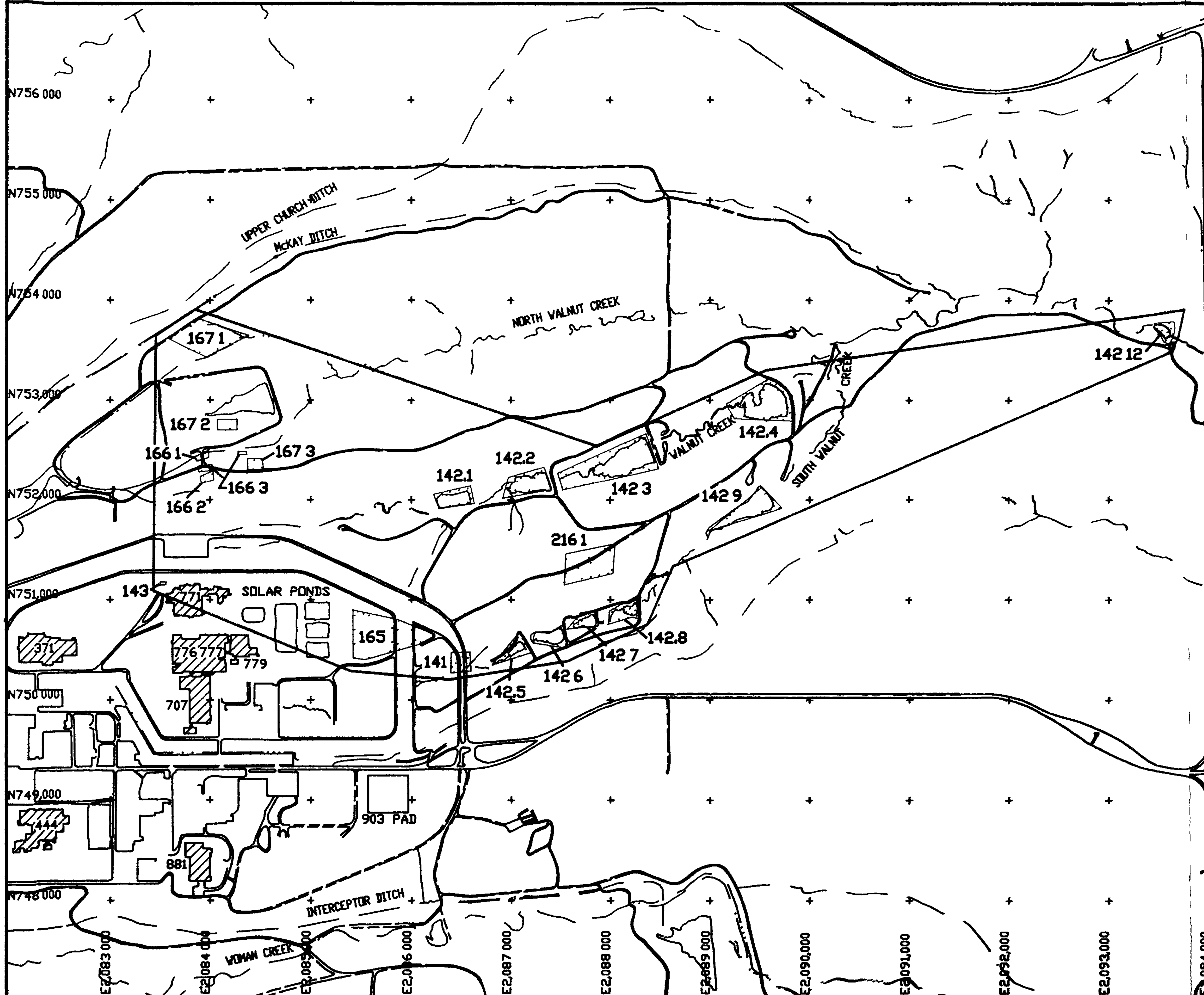


GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

OPERABLE UNIT 5 WOMAN CREEK

EG&G

Rocky Flats Plant, Golden, Colorado



MAP LEGEND

OPERABLE UNIT

STREAMS DITCHES DRAINAGE FEATURES

PAVED ROADS

DIRT ROADS

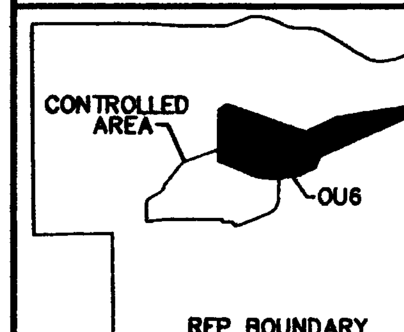
BUILDINGS

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

N

0 500 1000

SCALE. 1 = 1000

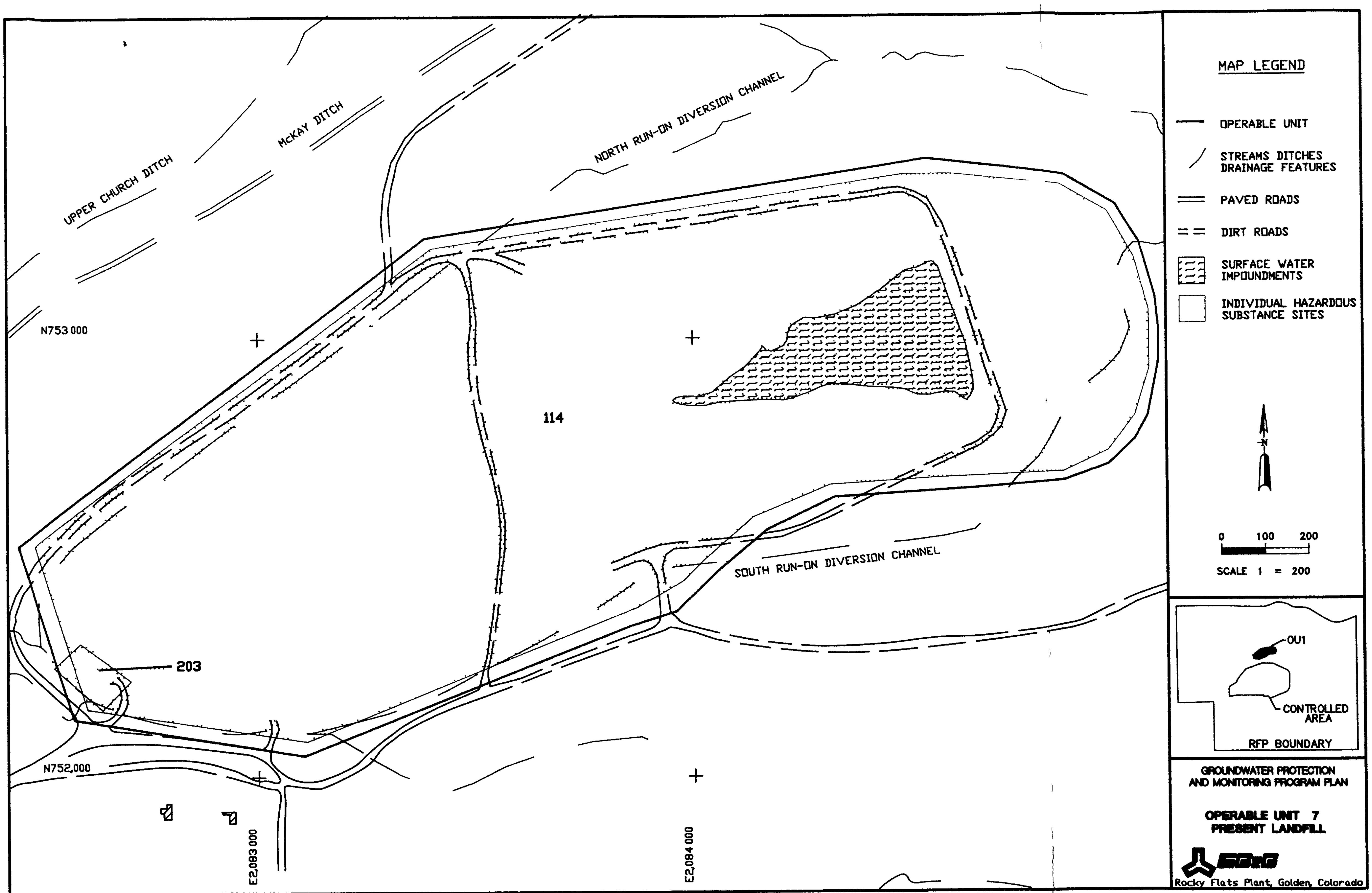


GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

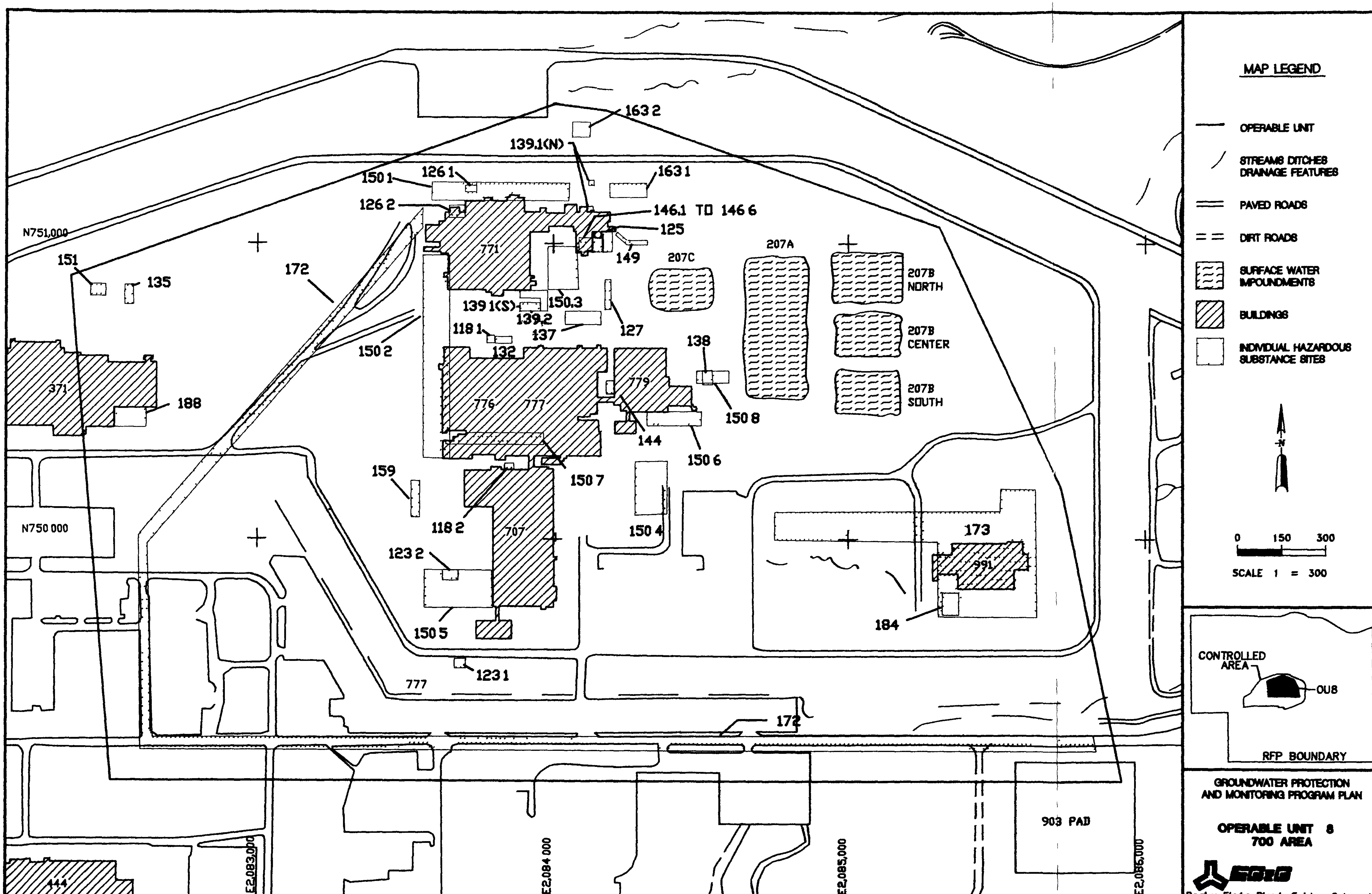
OPERABLE UNIT 6
WALNUT CREEK

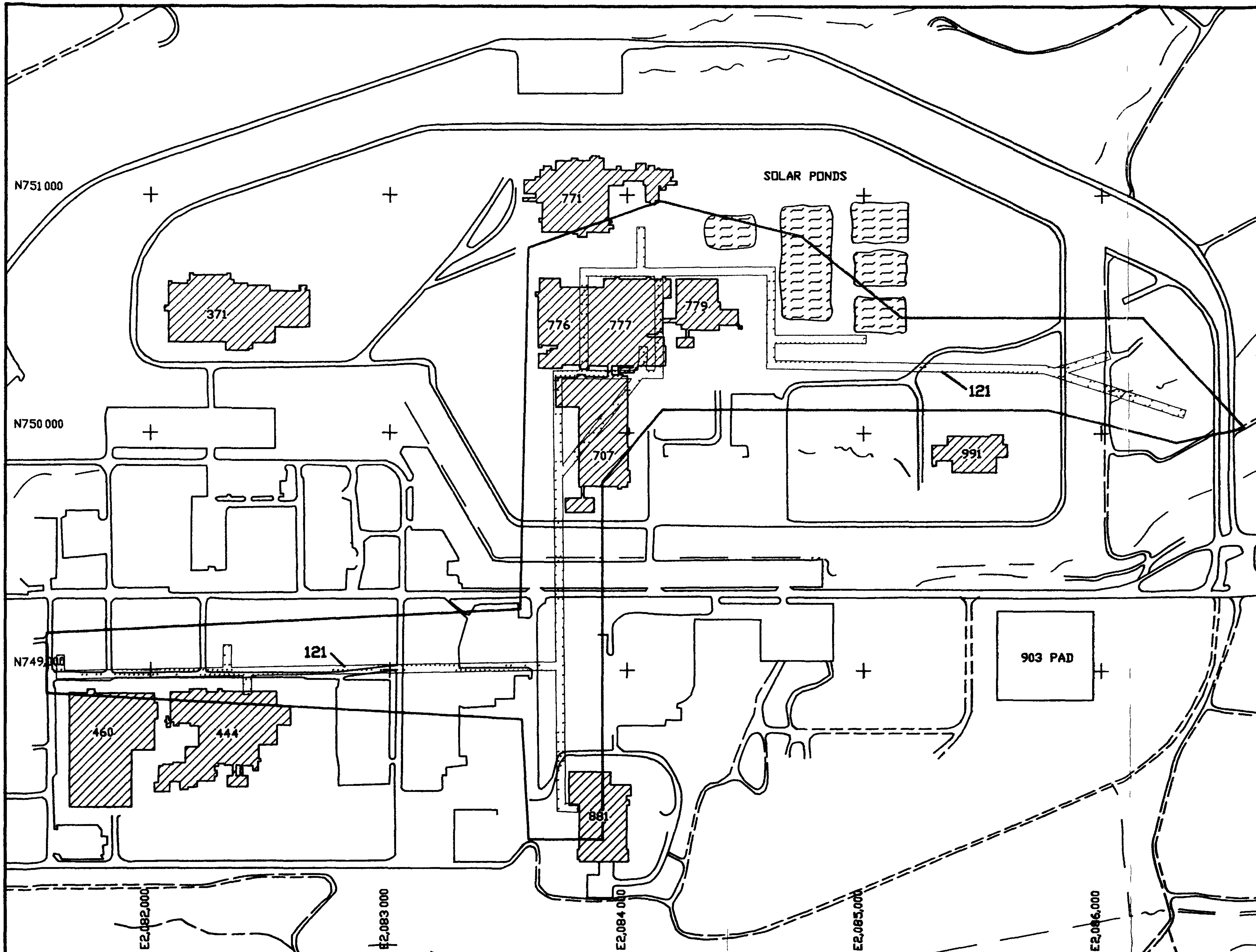
EG&G

Rocky Flats Plant, Golden, Colorado



MAP LEGEND
OPERABLE UNIT
STREAMS DITCHES DRAINAGE FEATURES
PAVED ROADS
DIRT ROADS
SURFACE WATER IMPOUNDMENTS
INDIVIDUAL HAZARDOUS SUBSTANCE SITES
N
0 100 200
SCALE 1 = 200
OU1
CONTROLLED AREA
RFP BOUNDARY
GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN
OPERABLE UNIT 7 PRESENT LANDFILL
EG&G
Rocky Flats Plant, Golden, Colorado
UPPER CHURCH DITCH
McKAY DITCH
NORTH RUN-ON DIVERSION CHANNEL
SOUTH RUN-ON DIVERSION CHANNEL
114
203
N753 000
N752,000
E2,083 000
E2,084 000

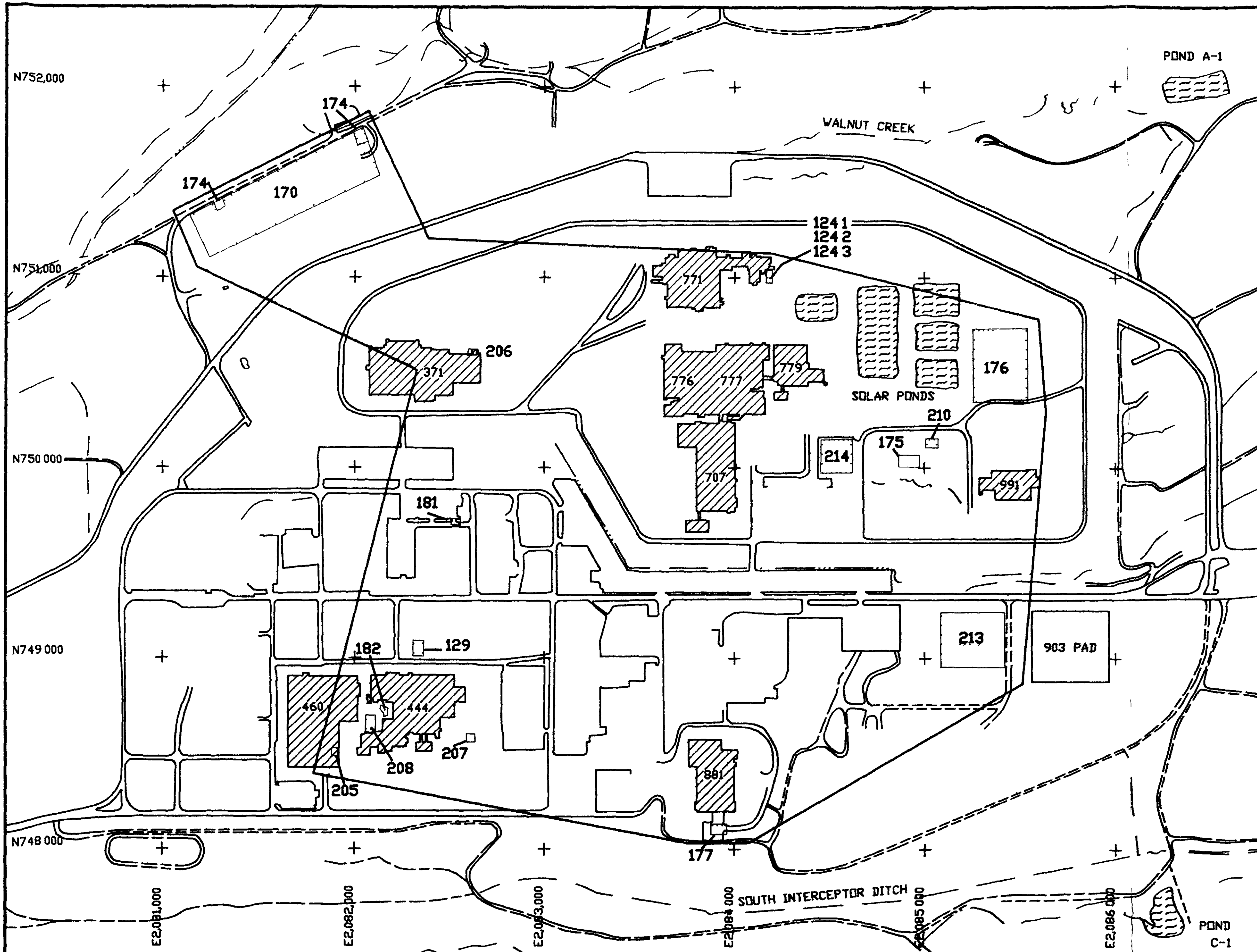

MAP LEGEND
OPERABLE UNIT
STREAMS DITCHES DRAINAGE FEATURES
PAVED ROADS
DIRT ROADS
SURFACE WATER IMPOUNDMENTS
BUILDINGS
INDIVIDUAL HAZARDOUS SUBSTANCE SITES
N
0 150 300
SCALE 1 = 300
CONTROLLED AREA
OU8
RFP BOUNDARY
GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN
OPERABLE UNIT 8
700 AREA
Rocky Flats Plant, Golden, Colorado
163 2
139.1(N)
163 1
150 1
126 1
126 2
146.1 TO 146 6
125
149
771
207C
207A
207B NORTH
207B CENTER
207B SOUTH
N751,000
151
135
172
139 1(S)
150.3
139.2
127
118 1
137
150 2
132
138
779
371
188
776
777
150 8
144
150 6
150 7
159
118 2
707
150 4
173
991
N750 000
123 2
150 5
184
123 1
777
172
903 PAD
E2,083,000
E2,084 000
E2,085,000
E2,086,000
444



GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

OPERABLE UNIT 9 ORIGINAL PROCESS WASTE LINES

EG&G Rocky Flats Plant, Golden, Colorado



MAP LEGEND

OPERABLE UNIT

STREAMS DITCHES DRAINAGE FEATURES

PAVED ROADS

DIRT ROADS

SURFACE WATER IMPOUNDMENTS

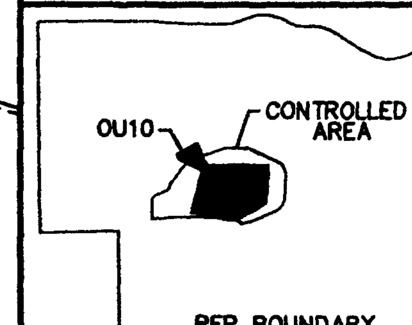
BUILDINGS

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

N

0 250 500

SCALE 1 = 500

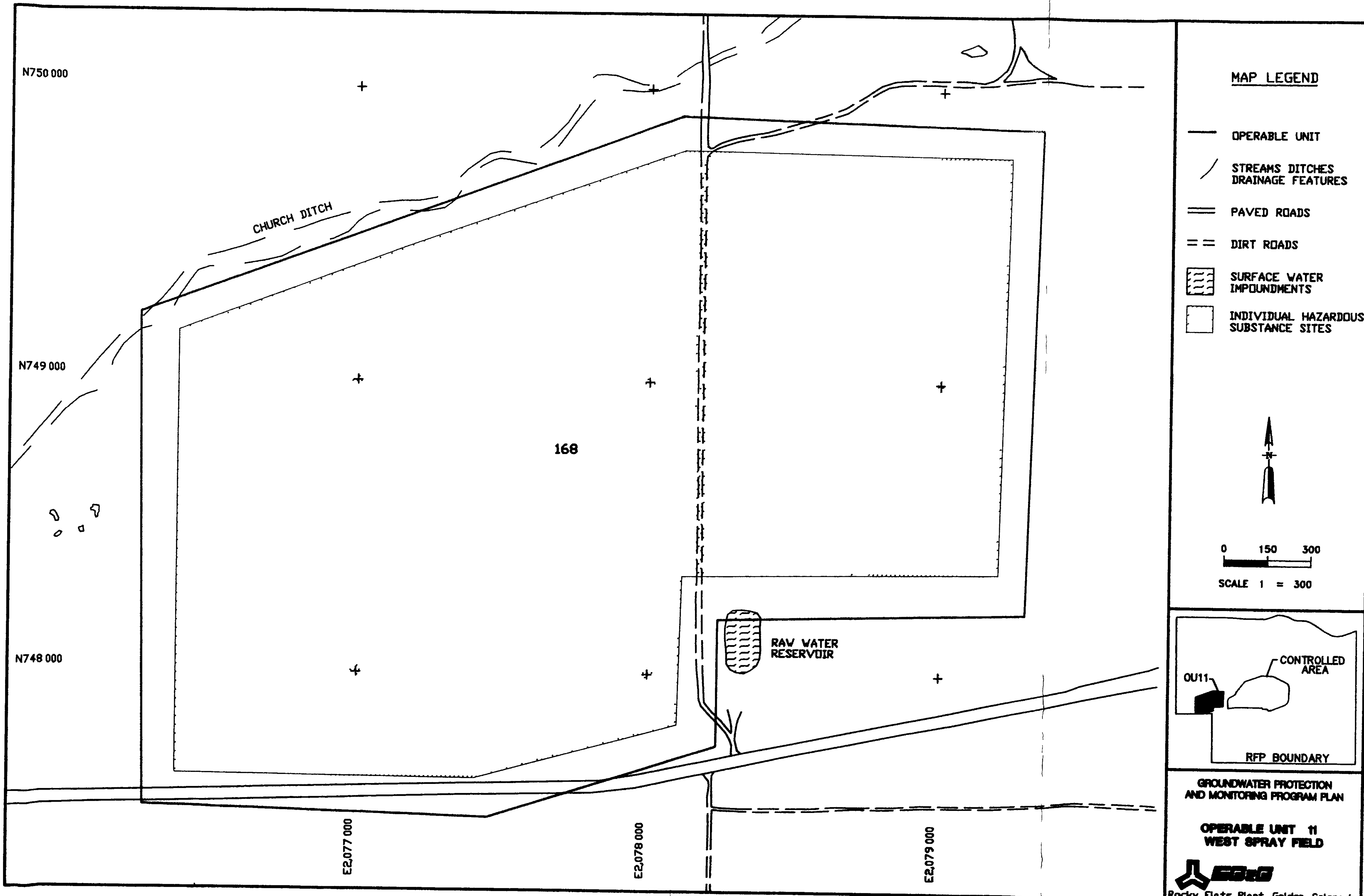


GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

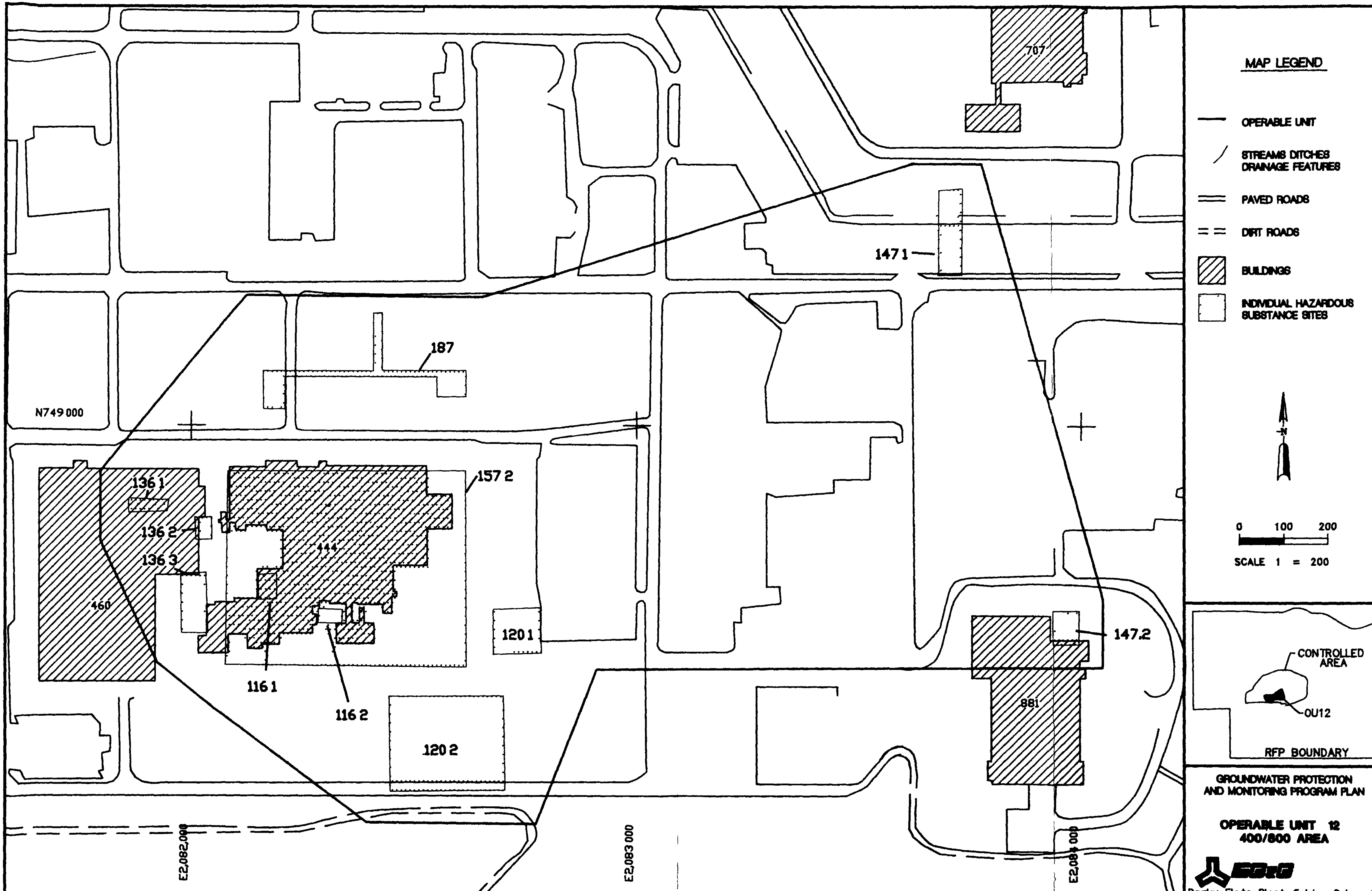
OPERABLE UNIT 10
OTHER OUTSIDE CLOSURES

EG&G

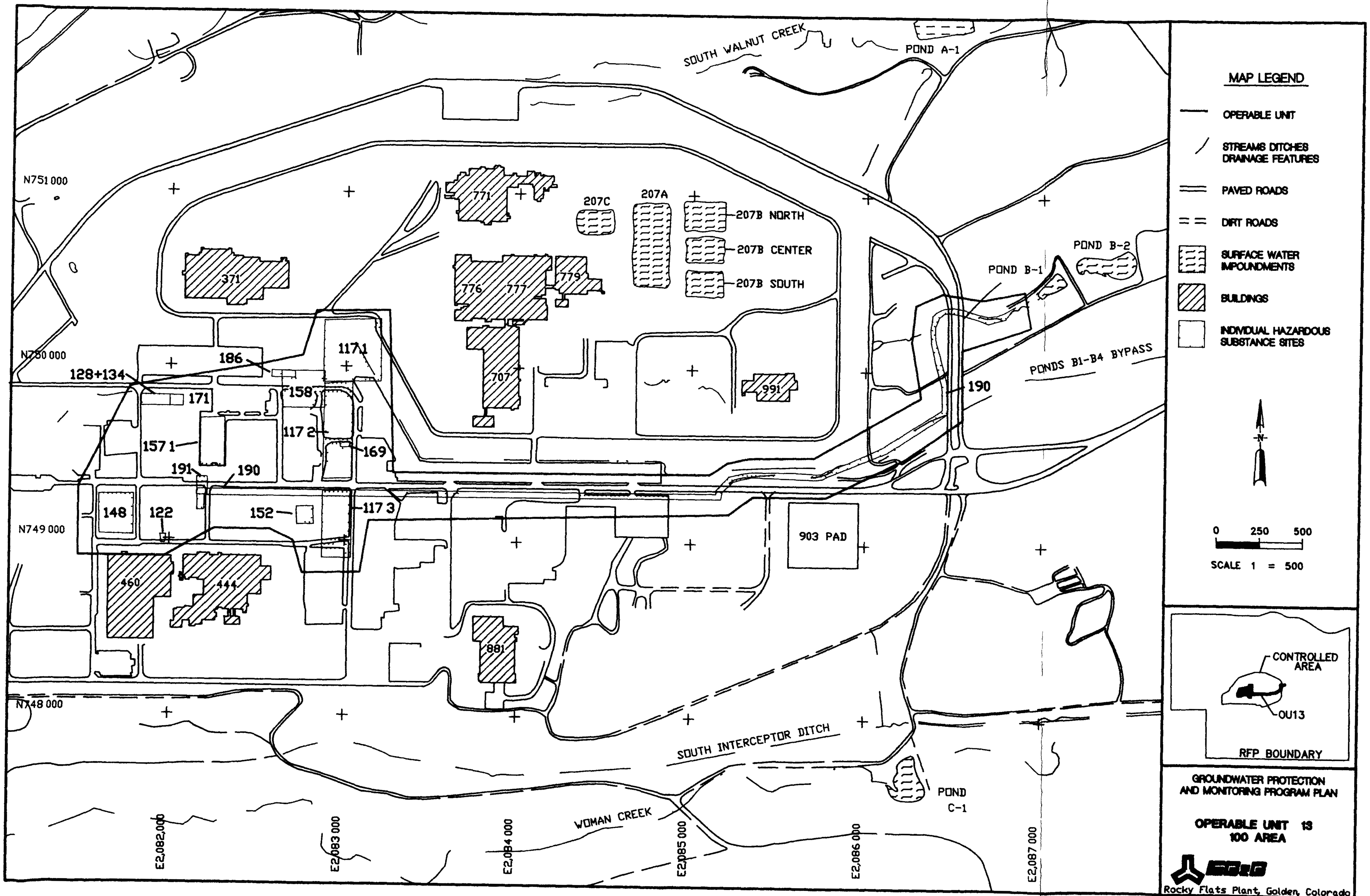
Rocky Flats Plant, Golden, Colorado

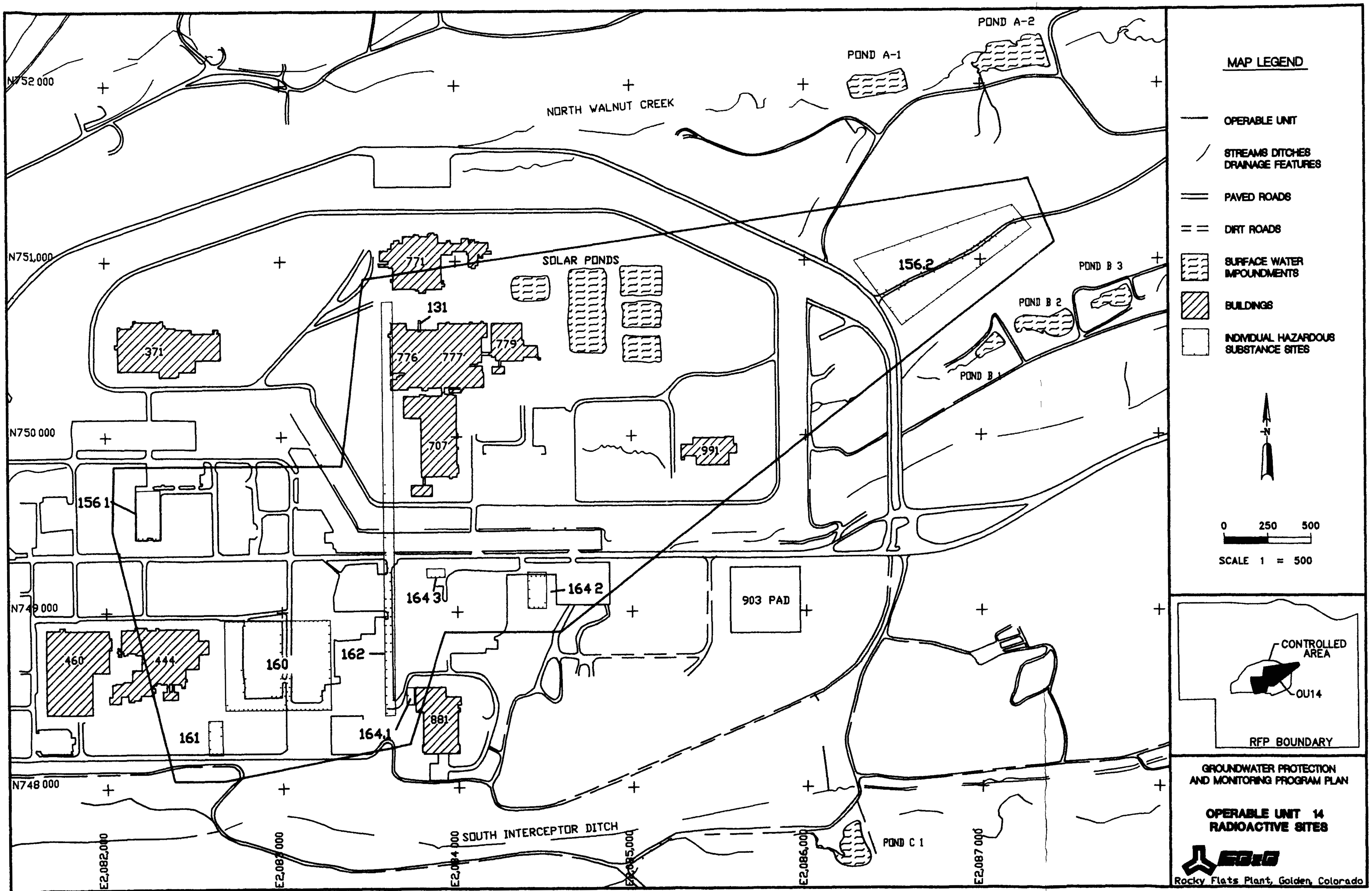


MAP LEGEND
OPERABLE UNIT
STREAMS DITCHES DRAINAGE FEATURES
PAVED ROADS
DIRT ROADS
SURFACE WATER IMPOUNDMENTS
INDIVIDUAL HAZARDOUS SUBSTANCE SITES
N
0 150 300
SCALE 1 = 300
OU11
CONTROLLED AREA
RFP BOUNDARY
GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN
OPERABLE UNIT 11
WEST SPRAY FIELD
EG&G
Rocky Flats Plant, Golden, Colorado
N750 000
N749 000
N748 000
E2,077 000
E2,078 000
E2,079 000
CHURCH DITCH
168
RAW WATER RESERVOIR

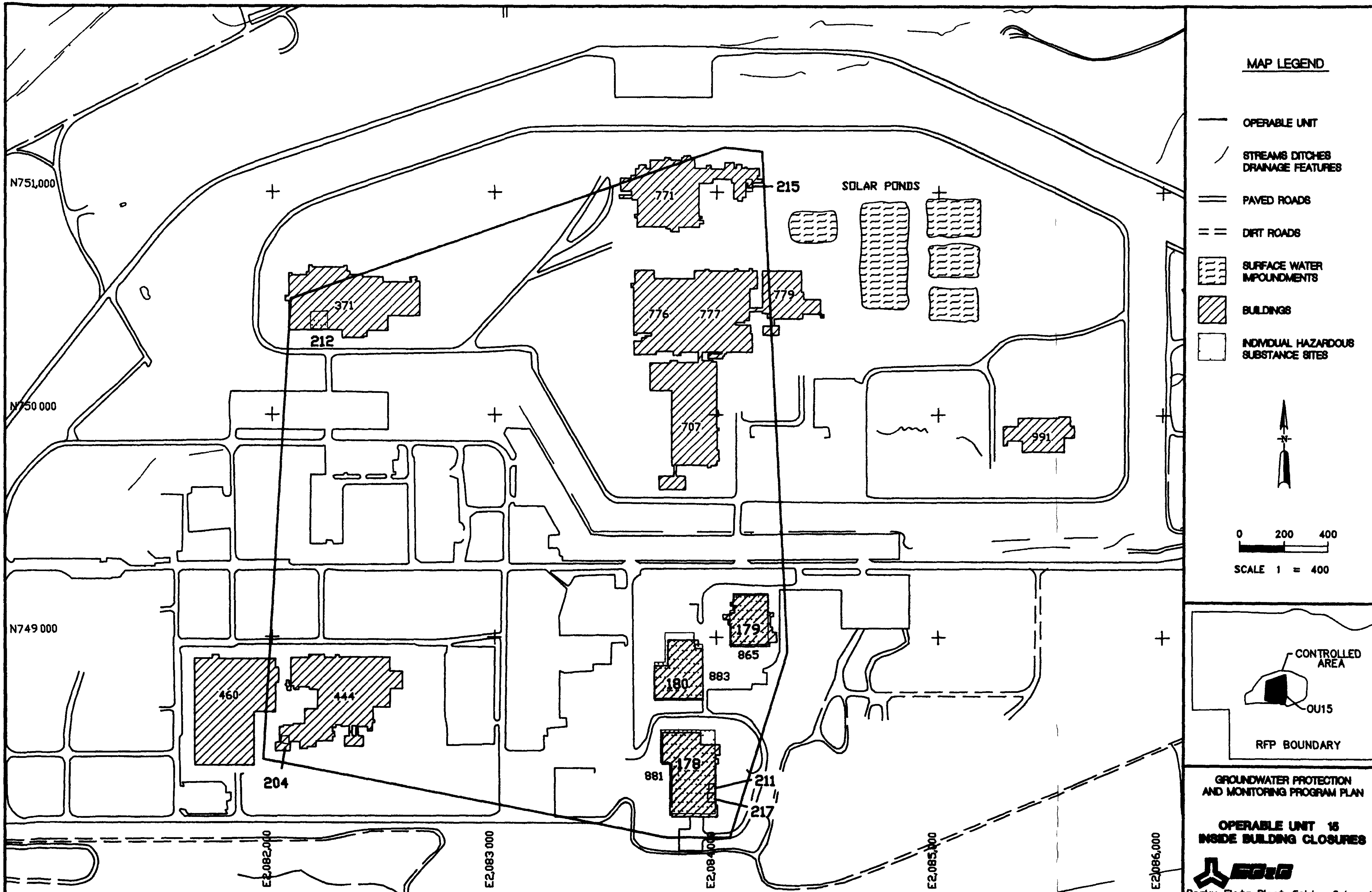


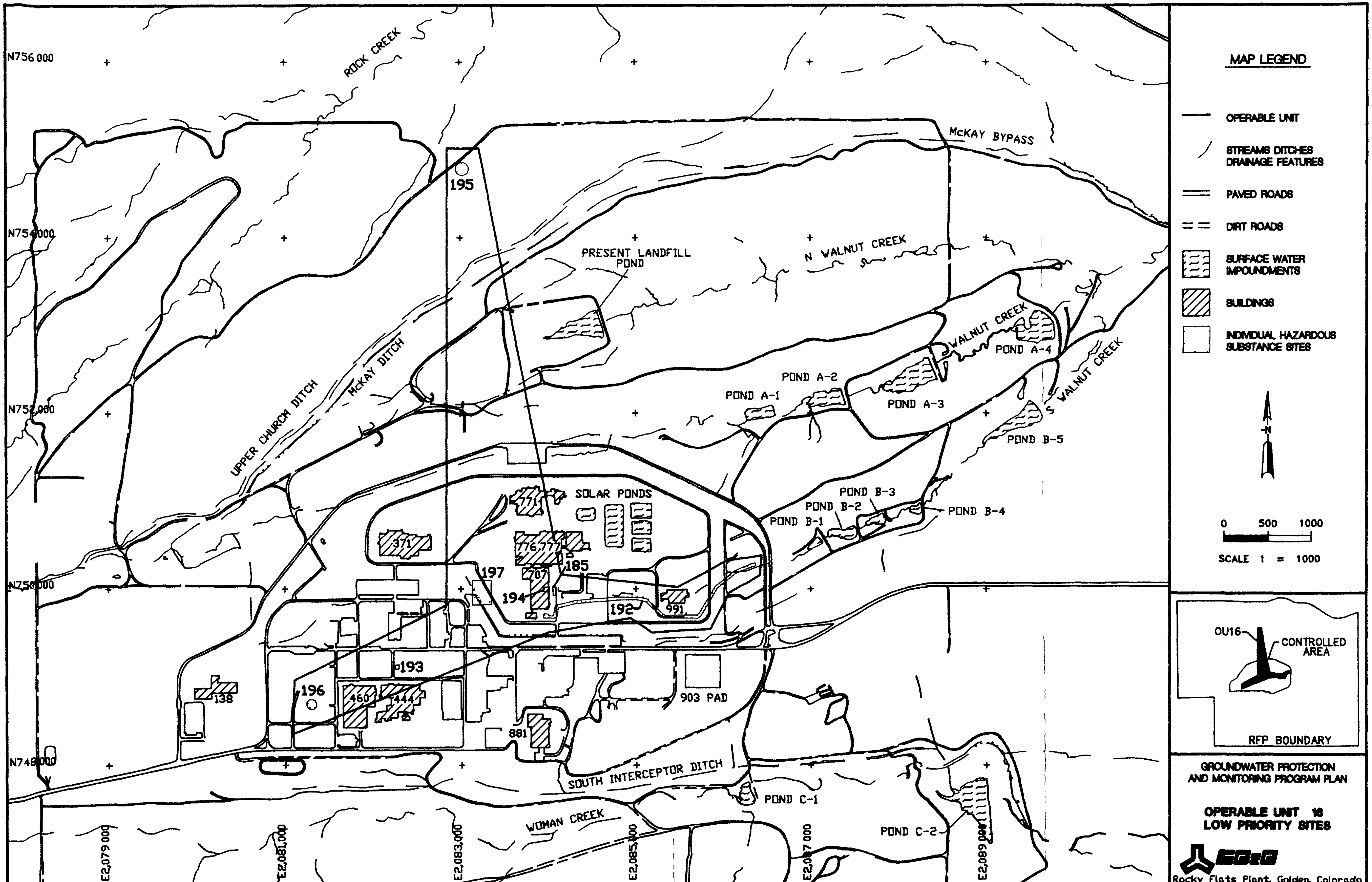
MAP LEGEND
OPERABLE UNIT
STREAMS DITCHES DRAINAGE FEATURES
PAVED ROADS
DIRT ROADS
BUILDINGS
INDIVIDUAL HAZARDOUS SUBSTANCE SITES
N
0 100 200
SCALE 1 = 200
CONTROLLED AREA
OU12
RFP BOUNDARY
GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN
OPERABLE UNIT 12
400/800 AREA
EG&G
Rocky Flats Plant, Golden, Colorado
707
147 1
187
N749 000
136 1
136 2
136 3
444
157 2
460
116 1
116 2
120 1
120 2
147.2
881
E2,082,000
E2,083 000
E2,084 000

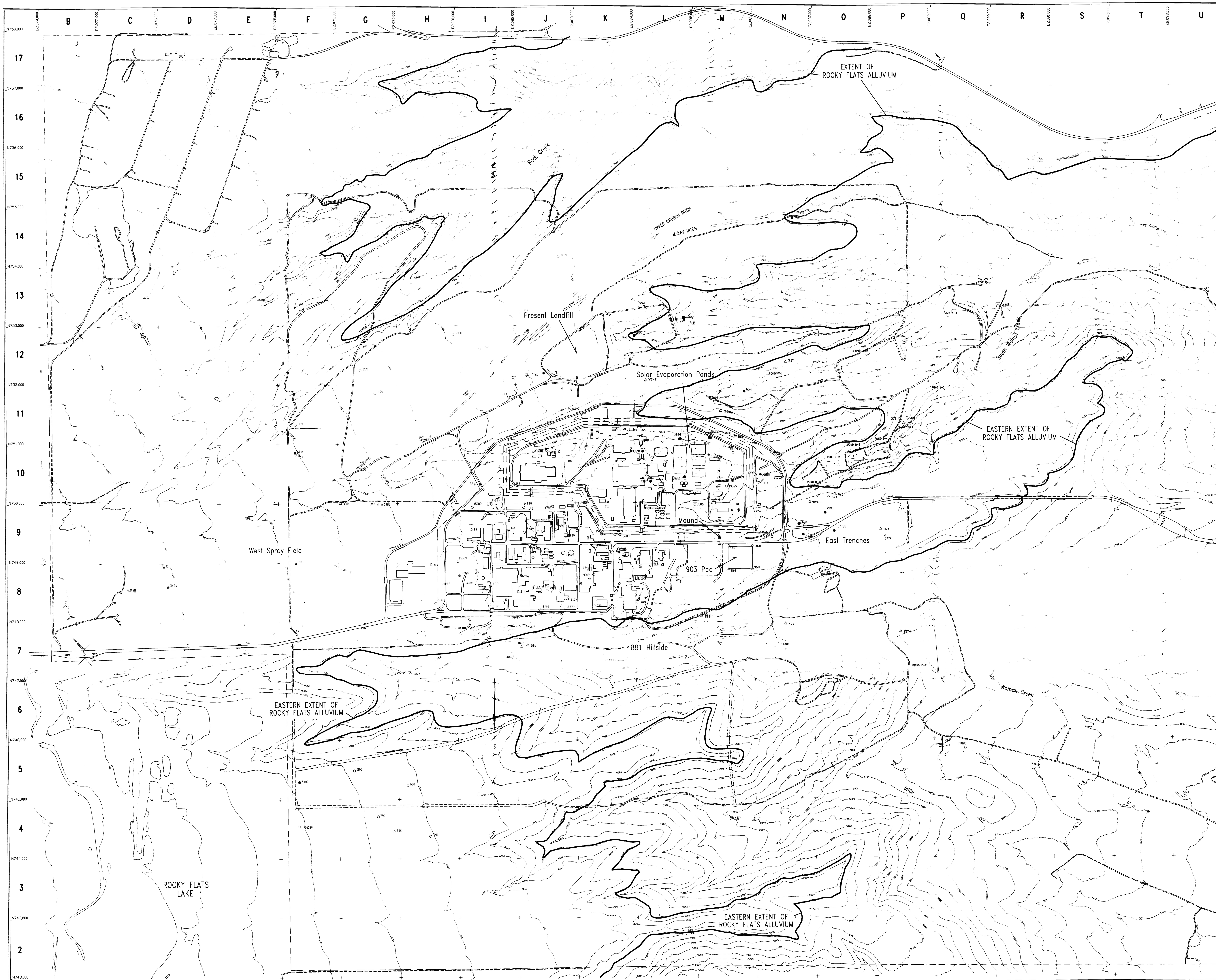

MAP LEGEND
OPERABLE UNIT
STREAMS DITCHES DRAINAGE FEATURES
PAVED ROADS
DIRT ROADS
SURFACE WATER IMPOUNDMENTS
BUILDINGS
INDIVIDUAL HAZARDOUS SUBSTANCE SITES
N
0 250 500
SCALE 1 = 500
CONTROLLED AREA
OU13
RFP BOUNDARY
GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN
OPERABLE UNIT 13
100 AREA
Rocky Flats Plant, Golden, Colorado
SOUTH WALNUT CREEK
POND A-1
POND B-1
POND B-2
PONDS B1-B4 BYPASS
207A
207B NORTH
207B CENTER
207B SOUTH
207C
771
776
777
779
707
991
371
1171
186
128+134
171
158
1172
1571
169
191
190
148
122
152
1173
460
444
881
903 PAD
SOUTH INTERCEPTOR DITCH
POND C-1
WOMAN CREEK
N751 000
N750 000
N749 000
N748 000
E2,082,000
E2,083 000
E2,084 000
E2,085 000
E2,086 000
E2,087 000



POND A-2
POND A-1
NORTH WALNUT CREEK
SOLAR PONDS
156.2
POND B 3
POND B 2
POND B 1
771
131
371
776
777
779
707
991
156 1
164 3
164 2
903 PAD
162
160
460
444
881
164.1
161
SOUTH INTERCEPTOR DITCH
POND C 1
N752 000
N751,000
N750 000
N749 000
N748 000
E2,082,000
E2,083 000
E2,084 000
E2,085,000
E2,086,000
E2,087 000
MAP LEGEND
OPERABLE UNIT
STREAMS DITCHES DRAINAGE FEATURES
PAVED ROADS
DIRT ROADS
SURFACE WATER IMPOUNDMENTS
BUILDINGS
INDIVIDUAL HAZARDOUS SUBSTANCE SITES
N
0 250 500
SCALE 1 = 500
CONTROLLED AREA
OU14
RFP BOUNDARY
GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN
OPERABLE UNIT 14 RADIOACTIVE SITES
Rocky Flats Plant, Golden, Colorado


MAP LEGEND
OPERABLE UNIT
STREAMS DITCHES DRAINAGE FEATURES
PAVED ROADS
DIRT ROADS
SURFACE WATER IMPOUNDMENTS
BUILDINGS
INDIVIDUAL HAZARDOUS SUBSTANCE SITES
N
0 200 400
SCALE 1 = 400
CONTROLLED AREA
OU15
RFP BOUNDARY
GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN
OPERABLE UNIT 15
INSIDE BUILDING CLOSURES
Rocky Flats Plant, Golden, Colorado
SOLAR PONDS
215
771
371
212
776
777
779
707
991
179
865
180
883
178
881
211
217
460
444
204
N751,000
N750 000
N749 000
E2,082,000
E2,083 000
E2,084,000
E2,085,000
E2,086,000


ROCK CREEK
McKAY BYPASS
N WALNUT CREEK
PRESENT LANDFILL POND
WALNUT CREEK
POND A-4
S WALNUT CREEK
POND A-1
POND A-2
POND A-3
POND B-5
UPPER CHURCH DITCH
McKAY DITCH
SOLAR PONDS
POND B-1
POND B-2
POND B-3
POND B-4
195
771
371
776,777
185
197
707
194
192
991
193
196
138
460
444
881
903 PAD
SOUTH INTERCEPTOR DITCH
POND C-1
WOMAN CREEK
POND C-2
N756 000
N754 000
N752 000
N750 000
N748 000
E2,079 000
E2,081,000
E2,083,000
E2,085,000
E2,087 000
E2,089 000
MAP LEGEND
OPERABLE UNIT
STREAMS DITCHES DRAINAGE FEATURES
PAVED ROADS
DIRT ROADS
SURFACE WATER IMPOUNDMENTS
BUILDINGS
INDIVIDUAL HAZARDOUS SUBSTANCE SITES
N
0 500 1000
SCALE 1 = 1000
OU16
CONTROLLED AREA
RFP BOUNDARY
GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN
OPERABLE UNIT 16 LOW PRIORITY SITES
EG&G
Rocky Flats Plant, Golden, Colorado



U.S. DEPARTMENT OF ENERGY

GROUNDWATER PROTECTION AND MONITORING PROGRAM PLAN

WELL AND PIEZOMETER LOCATIONS
INDIVIDUAL HAZARDOUS SUBSTANCE SITES

EG&G

PLATE 1

Rocky Flats Plant, Golden, Colorado

PREPARED FOR:

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

PLATE 3

TITLE:

NEW PACs

REVISED 5/22/92

PROJ. NO.	304944	DWG. NO.	304944-M2
DESIGN BY	C. BENTZ	CHECKED	
DRAWN BY	C. BENTZ	APPROVED	
DATE	12/17/91	SCALE	AS SHOWN